



**Pan-American Institute of Geography and History (PAIGH)
Geocentric Reference System for the Americas (SIRGAS)
Regional Committee of the United Nations on Global
Geospatial Information Management for the Americas
(UN-GGIM: Americas)
CAF/PAIGH GeoSUR Program**

**2016-2020 JOINT ACTION PLAN
TO EXPEDITE THE DEVELOPMENT OF
SPATIAL DATA INFRASTRUCTURE
OF THE AMERICAS**

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Table of Contents

Acknowledgements

Executive Summary

I. INTRODUCTION

II. INSTITUTIONAL FRAMEWORK

1. Pan-American Institute of Geography and History (PAIGH)
2. Geocentric Reference System for the Americas (SIRGAS)
3. Regional Committee of the United Nations on Global Geospatial Information Management for the Americas (UN-GGIM: Americas)
4. CAF/PAIGH GeoSUR Program

III. COMMON SDI ELEMENTS OF THE PAIGH, SIRGAS,
UN-GGIM: AMERICAS AND GEOSUR, WORK PLANS

1. The interrelationship of the action plans for SDI-Related initiatives from the PAIGH's perspective
2. The interrelationship of the action plans for SDI-Related initiatives from the SIRGA's perspective
3. The interrelationship of the action plans for SDI-Related initiatives from the UN-GGIM: Americas' perspective
4. The interrelationship of the action plans for SDI-Related initiatives from the GeoSUR's perspective

IV. 2016-2020 JOINT ACTION PLAN

1. Proposals by the PAIGH

2. Proposals by the SIRGAS
3. Proposals by the UN-GGIM: Americas
4. Proposals by GeoSUR

List of Acronyms

References

Commitment Document

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Executive Summary

As a contribution to the development of data infrastructure in the Americas, the regional bodies essential to its consolidation (PAIGH, SIRGAS, UN-GGIM: Americas and GeoSUR) present this document to the specialist community with the aim of harmonizing their efforts and work plans, promoting specialization, avoiding duplication and preparing relevant institutions for the continuous technological changes and innovations that arise in this field of development.

Instead of promoting a new form of government for regional Spatial Data Infrastructure (SDI), the intention is to consolidate a distributed system of responsibilities, respecting the independence required by the parties. In this way it is hoped to consolidate the role of the PAIGH as a key coordinator of regional processes and capacity-builder in line with the character of its Cartography Commission; the role of SIRGAS as single supplier of the geodesic frame of reference for the region; the high level of responsibility of UN-GGIM: Americas as coordinator of regional and institutional policies and as a direct link with the United Nations and GeoSUR as a developer of services and applications on the basis of institutional and regional databases of spatial data.

These objectives are set out in this Joint Action Plan, which has been developed on the basis of a comparative exercise that accounts for the characteristics of each organization, its functions, work plans and, especially, its institutional projection.

This effort reflects the existing consensus among the leaders of the four participating bodies insofar as the SDI for the Americas will not become a tangible and sustainable reality through individual actions but will require the harmonious work and coordinated action of all, as its members demand. In addition, it is an exercise that takes into account the global connections of each body, as is the case of the PAIGH and its function as liaison for multiple international organizations; of SIRGAS with the International Association of Geodesy (IAG); of UN-GGIM: Americas and its close relationship with the United Nations (and especially with UN-GGIM); or of GeoSUR with the Conference and the Eye on Earth network.

This document has been presented to the relevant bodies of PAIGH, SIRGAS, UN-GGIM: Americas and GeoSUR for incorporation and to share it with the international community, in such a way that its application is the result of the collective effort required to spatially enable all the peoples of the Americas and the Caribbean.

I. INTRODUCTION

By its nature, the construction of an SDI is a dynamic and long-term process that brings together concepts, methods, cultural and institutional aspects as well as scientific and technological resources, capital and specialists to make geospatial information available to development on multiple levels.¹

The construction of the regional infrastructure of the Americas is framed within these parameters, as indicated by the most recent diagnosis by UN-GGIM: Americas (GTPlan).² Undoubtedly, this process is not easy. Nor has it been in other regions of the world, such as Africa, Asia and the Pacific, and although the regional or supranational level is perhaps the most difficult to deal with, it is necessary to recognize the advances made in Europe with the INSPIRE initiative.³

In the Americas, the construction of the regional SDI is the outcome of many years of effort by multiple sectors. This is a brief summary of the major milestones:

- The establishment of SIRGAS at the "International Conference for the definition of a Geocentric Reference System for South America," in Asunción (Paraguay, 1993);
- The establishment in 1995 of the Inter-American Geospatial Data Network (IGDN);
- The set of resolutions adopted at the four United Nations Regional Cartographic Conferences for the Americas, which have met every four years since 1997;
- The Act of February 2000, issued in Bogota (Colombia), through which 21 American nations created the Permanent Committee for Geospatial Data Infrastructure of the Americas (CP-IDEA);
- The recommendations issued at the Consultation Meetings of the Cartography Commission in 2001 and 2005, and the respective meetings of the 18th General Assembly of PAIGH (Venezuela, 2005), the Declaration "Development of Spatial Data Infrastructures in America" by the Directing Council of PAIGH, issued in Bogotá in 2007, and the "PAIGH 2010-2020 Pan-American Agenda";
- The Inter-American Science and Technology Program of the Organization of American States - OAS (Peru, 2003) which incorporated the "Hemispheric Cooperation Initiative in the Field of Geographic Information for the Integral Development of the Americas" and Resolution 2328 of the 37th General Assembly of the OAS (Panama, 2007);

¹ Definition of SDI: "The Global Spatial Data Infrastructure supports global and public access to geographic information. This is achieved through coordinated actions among countries and organizations that promote awareness-raising and implementation of harmonious policies, standardization and effective mechanisms for development, accessibility and interoperability of digital geographic data and technologies, as a basis for decision-making on all scales and to multiple ends. These actions therefore comprise the policies, organizational management, data, technologies, standards, transmission mechanisms and human and financial resources required to ensure that those working at global and regional levels do not meet obstacles to achieving their objectives." <<http://www.gsdi.org>>

² <<http://www.snit.cl/cpidea/index.php/component/jdownloads/finish/42-9-reunion-cp-idea/245-diagnostico-sobre-temas-relevantes-de-la-gestion-de-informacion-geoespacial-y-desarrollo-de-las-infraestructuras-de-datos-espaciales--ide-en-los-paises-de-las-americas?Itemid=0>>

³ <<http://inspire.jrc.ec.europa.eu/>>

Joint Plan of Action 2016-2020 to Accelerate the Development of SDI in the Americas

- The signing of a collaboration agreement between the Andean Development Corporation (CAF) and the PAIGH for coordination of the GeoSUR Program, undertaken in Brasilia, in March 2007;
- Publication of the family of standards of the International Organization for Standardization (ISO) in Spanish in 2011 and the global conferences of the Association for the Global Spatial Data Infrastructure (GSDI) held in the region (Colombia, 2001; Chile, 2006; Trinidad and Tobago, 2008 and Canada, 2012).
- The 44th Meeting of the Directing Council of the PAIGH which circulated the first version of this Joint Action Plan, the 45th Meeting of the Directing Council of the PAIGH which ratified and endorsed a new document, Resolution No. 1 of the 46th Meeting of the Directing Council of the PAIGH, which agrees to update this plan.
- The Seventh Resolution of the 10th United Nations Regional Cartographic Conference for the Americas (New York, 2013), as a result of which the name "Permanent Committee for Geospatial Data Infrastructure of the Americas" (CP-IDEA) was changed to "Regional Committee of the United Nations Global Geospatial Information Management for the Americas" (UN-GGIM: Americas) and the number of member countries increased from 24 to 38 with the inclusion of the Caribbean region.

Much remains to be done. Speeding up this process is an obligation for the leaders and active members of the truly regional initiatives, sustained and projected in the Americas, such as the Cartography Commission of the PAIGH, SIRGAS, UN-GGIM: Americas and GeoSUR. To achieve this, it is essential to count on the support of the CAF - Development Bank of Latin America- the UN Committee of Experts on GGIM, and the PAIGH.⁴

The case of the PAIGH is particular: as a specialized organization of the OAS, in charge of the geospatial component, it has supported Member States in their efforts toward the establishment of the SDI at the national and regional levels, through the National Geographic Institutes and in the creation and development of SIRGAS, CP-IDEA (now UN-GGIM: Americas) and GeoSUR. However, beyond the important work carried out by the PAIGH Cartography Commission since 1946, the role of the PAIGH has essentially been—and in the future it should consolidate this role—as a key "facilitator" for regional processes and as an advocate for building capacities that correspond to the leadership and nature of SIRGAS, UN-GGIM: Americas and GeoSUR, as essential pillars for the SDI in the Americas and the Caribbean.

In this context, and with the aim of accelerating construction and development of the SDI in the Americas, the present policy document is submitted to the specialized community, constituting the Second Edition of this Plan, now extended to the period 2016-2020. Its purpose is to harmonize the efforts and the work plans of these initiatives, as well as to foster the specialization of each of them, avoiding duplication and preparing the relevant actors and institutions to confront, in the best possible way, the continuing challenges, technological changes and innovations, which include among others:

⁴ In this process it is important to have general support from multilateral agencies for regional and global cooperation, such as the Inter-American Development Bank (IDB), the World Bank, and the international associations related to spatial information such as the International Association of Geodesy (IAG), International Society for Photogrammetry and Remote Sensing (ISPRS), International Cartographic Association (ICA), International Federation of Surveyors (FIG) and others of similar importance.

- Smart cities and the Internet of Things,
- Artificial intelligence and Big Data (macro data),
- Indoor positioning and mapping,
- Trends in technology and the generation, maintenance and management of data,
- Legal and policy developments,
- Knowledge requirements and training mechanisms,
- The role of the private and non-governmental sectors, and
- The future of the role of governments in the provision and management of geospatial data.

To these may be added the storage of data in the “cloud,” crowdsourcing or voluntary contribution of spatial data, the use of emerging techniques associated with macro data, the use of unmanned aircraft (UAS or drones) and the relevance of sharing, reusing and interoperating geospatial data at the regional level.⁵

The growing importance of the integration between geospatial and socioeconomic information should be noted. The latter is normally generated by the National Statistical Offices (NSOs), as a complete tool for the provision of basic information, referenced by coordinates and useful for decision-making processes in governmental, private and academic scenarios.

This will consolidate the SDI as an increasingly effective mechanism for supporting regional integration, the expansion of infrastructure for sustainable development in the Americas, and to address the challenges of the era, such as **climate change** and the fulfillment of the UN’s Sustainable Development Goals (SDGs) enshrined in the 2030 Agenda.

In this scenario, the undisputed role of SIRGAS as supplier of the geodetic reference frame for the region is self-evident, together with the responsibility of UN-GGIM: Americas as manager of regional policies and as a direct link with the United Nations,⁶ and the role of GeoSUR as a leading developer of applications and visualizations of regional databases of geospatial data.

In this way, this document will be presented to the relevant directive bodies of the PAIGH, SIRGAS, UN-GGIM: Americas and GeoSUR for incorporation into their respective work plans, and will be shared with the community of specialists in the Americas and the Caribbean to contribute decisively to achieving one of our key priorities: amidst the cultural diversity that defines us, to geospatially enable all the peoples of the Americas and the Caribbean.

⁵ "Future Trends in geospatial information management: the five to ten year vision". Second edition. http://ggim.un.org/docs/UN-GGIM-Future-trens_Second%20edition.pdf

⁶ Also with the UN Committee of Experts for the Global Geospatial Information Management <<http://ggim.un.org/>>.

II. INSTITUTIONAL FRAMEWORK

The following is a summary of the institutions responsible for the Joint Action Plan and the initiative. Interested readers who seek further information about the participating entities may follow the link that is appended to the end of each section.

1. Pan-American Institute of Geography and History (PAIGH)

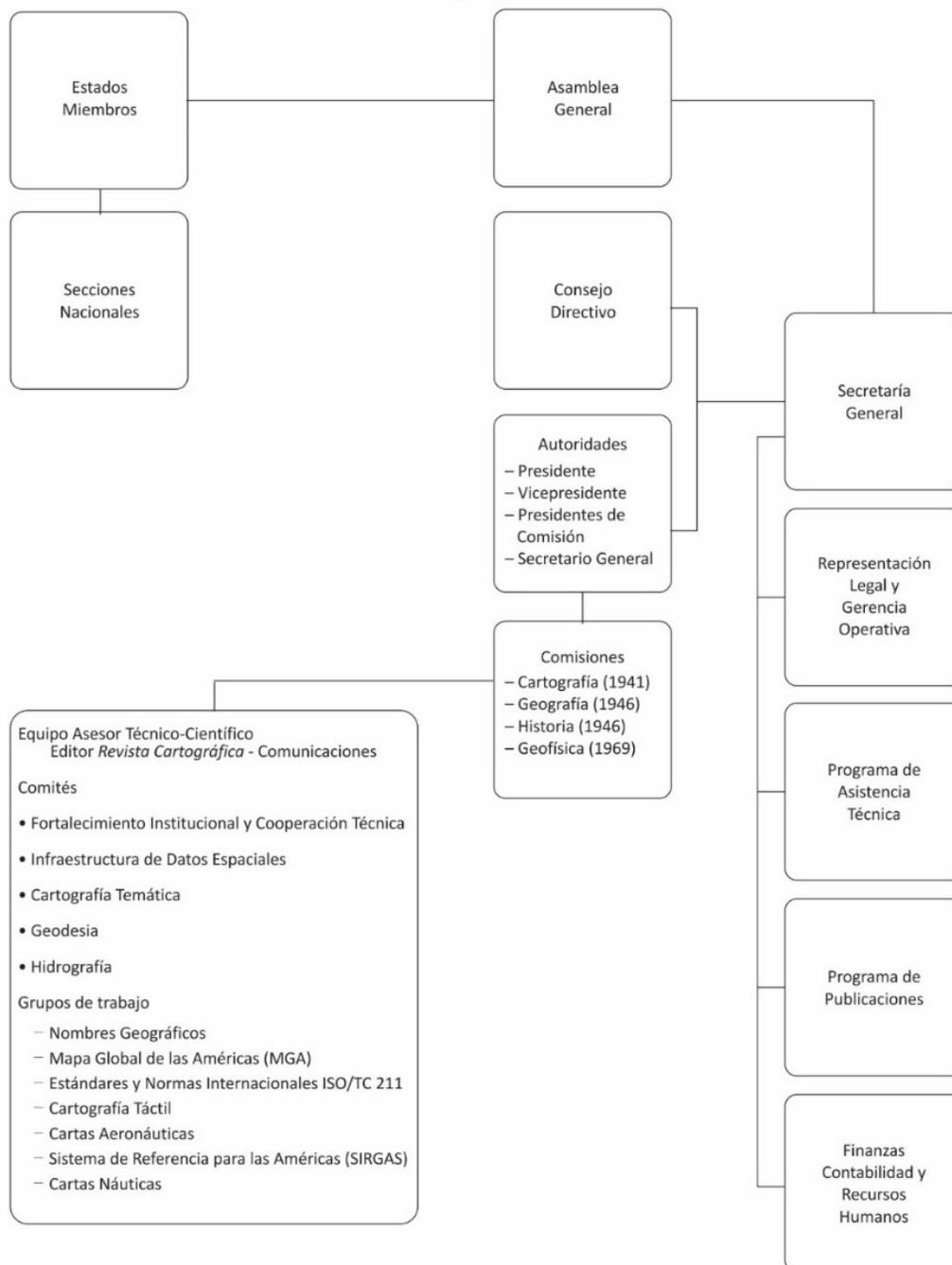
The PAIGH was founded on 7 February 1928 during the Sixth International Conference of American States held in Havana, Cuba. In January 1949, with the signing of an agreement with the Council of the Organization of American States (OAS), the first Specialized Agency of the Inter-American System was established. The PAIGH is an intergovernmental body whose essential purpose is to promote, coordinate and disseminate the research and work of specialists in cartography, geography, history and geophysics, stimulate cooperation between the specialized institutions of the Americas and international organizations, as well as to provide technical cooperation in the four areas mentioned. Its organizational structure comprises: The General Assembly, the Directing Council, the Commissions and the National Sections in each Member State. The General Secretariat is the central and permanent organ of the PAIGH, headquartered in Mexico City.

Through the Cartography Commission and the Technical Assistance Program, the PAIGH contributes to the development of the spatial component of the Inter-American system. For this purpose, in 2003 it established the "Hemispheric Cooperation Initiative in the Field of Geographic Information for the Integral Development of the Americas," which is part of the Inter-American Science and Technology Program (Peru, 2003). Subsequently, through Resolution 2328, the 37th General Assembly of the OAS (Panama, 2007) defined the role of the PAIGH as the "consolidation of the territorial databases of each country as part of the infrastructure necessary for social and economic development" in the Americas. On the basis of this resolution, the development of the new ten-year plan for consolidation of the PAIGH was begun, and the Declaration "Development of Spatial Data Infrastructures in America" (Colombia, 2007) was drawn up.

The current PAIGH Strategic Plan, entitled the "PAIGH 2010-2020 Pan-American Agenda" (Ecuador, 2009), states among its central aims that in order to consolidate the role of the Institute as an identifier and promoter of regional and institutional competencies, it strongly supports and participates in the implementation of different regional initiatives such as SIRGAS, UN-GGIM: Americas and the GeoSUR Program. Also, to strengthen the PAIGH as the natural Pan-American forum for the advancement of geographic information in the Member States, among other actions it promotes and supports the modernization programs of the Geographic Institutes responsible for national cartography, including the planned development of the fundamental spatial databases and their interoperability, the training of human resources and the certification of international standards and regulations. All these processes are essential for the development of Spatial Data Infrastructure in the Americas.

More information: <http://www.ipgh.org>

Figura 1
Instituto Panamericano de Geografía e Historia (IPGH)
Organigrama*



* Este organigrama tiene como destino este documento, por tanto no se han incluido los Comités y Grupos de Trabajo que componen otra Comisión distinta a la de Cartografía.

2. Geocentric Reference System for the Americas (SIRGAS)

SIRGAS was created at the “International Conference for the Definition of a Geocentric Reference System for South America,” held in 1993 in Asunción (Paraguay), with the purpose of resolving the problems set forth in the title of the Conference, leading to the generation of the acronym that identified that initiative, which was supported by the great majority of South American countries. Subsequently, the meaning of the last two letters in the acronym changed from "South America" to "the Americas" with the incorporation, in 2000, of Mexico, the countries of Central America and the Caribbean and the recommendation of the United Nations, in its Seventh Cartographic Conference of the Americas (New York, USA, January 22 to 26, 2001), indicating the adoption of SIRGAS as the official reference system in all countries of the Americas.

SIRGAS enjoys the support of the PAIGH, as a Working Group of the Cartography Commission, and of the International Association of Geodesy (IAG), where it is a component of Commission 1 (*Reference Frames*), through Sub-Commission 1.3 (*Regional Reference Frames*) and is responsible for 1.3b (*Regional Reference Frame for South and Central America*).

The operation of SIRGAS is supported by the human and material resources provided by more than 50 entities and by subsidies from the sponsoring institutions. Its institutional operation is controlled by a statute that assigns its governance to an Executive Committee, which is renewed every four years. With the support of a Scientific Council, this Committee fulfills the mission of executing the policies defined by the main body of the organization: the Directing Council, comprised of one principal representative and one alternate from each member country (20 at present) and one from each sponsoring entity. The work of SIRGAS is guided by three working groups: I) Reference System, II) SIRGAS at the national level, and III) Vertical Datum.

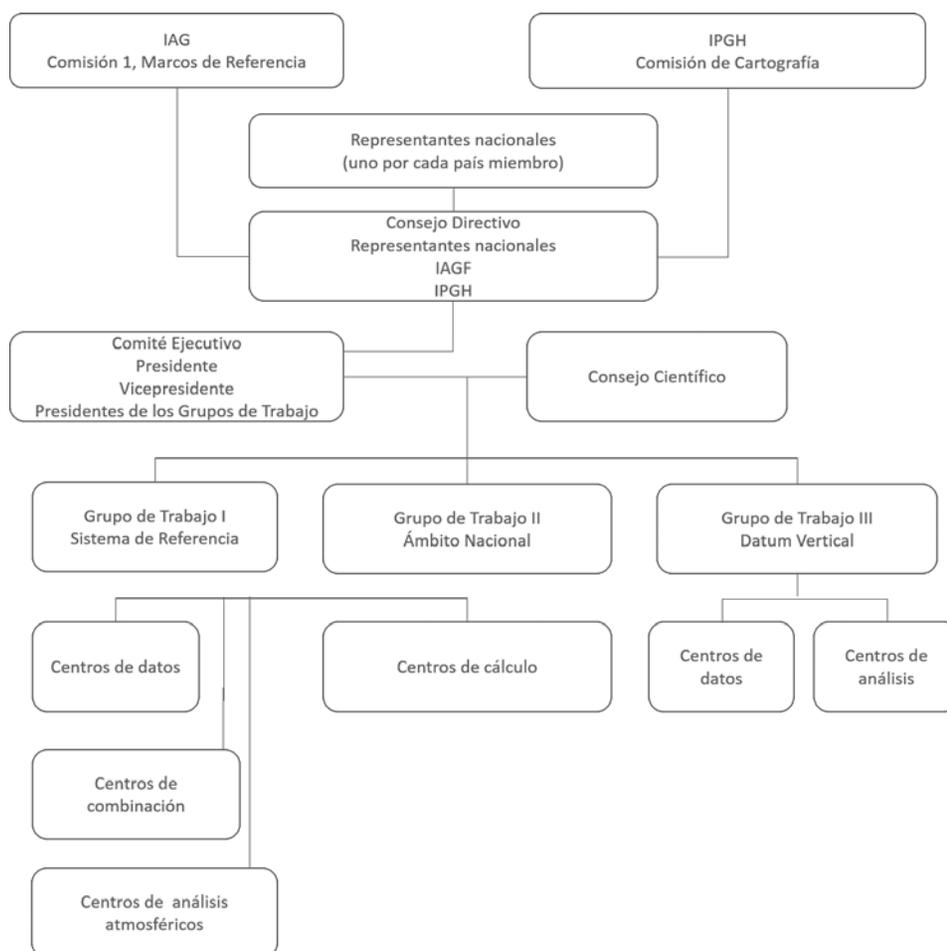
The guiding vision of SIRGAS is the consolidation, among all its member countries, of a geodetic system that is of a leading international scientific standard, articulated in collective work to ensure the availability of the most precise possible georeferencing database in any site in the region and at any moment in time. That vision gives rise to its mission, aimed at generating and placing at the disposal of Latin America and the Caribbean, data and products of geodetic origin that contribute to understanding the changing and complex relationship that exists between man and nature. This leads on to its principal current objective: to define, realize and maintain the three-dimensional geocentric reference system for the Americas (including a vertical reference system associated with the terrestrial gravity field) that provides: i) the fundamental layer in the generation, administration and implementation of spatial data (SDIs) and products; and ii) the basis for measurement, monitoring, modeling and understand the geodynamic processes and global change affecting the region.

Through its working groups, SIRGAS is continually engaged in a multiplicity of activities that include: i) the implementation of a vertical reference system associated with the Earth's gravity field, accurate and consistent on the continental and global scale, which requires the analysis of the contour and gravity networks of all Latin American countries, together with bathymetric observations and oceanic satellite altimetry; ii) support for the establishment of national reference frameworks linked to SIRGAS in countries that have not yet done so, and for the implementation of advanced positioning techniques (for example, so-called "real time"

techniques); iii) the continuous updating of the conventions and models used to develop the products that SIRGAS makes available to the community; iv) studies oriented towards the understanding of climate change, such as the production of maps of atmospheric variables and the monitoring of sea levels through tide gauges controlled with GNSS, and v) permanent technical support to a vast community linked to SIRGAS and to the Organization of American States, through the PAIGH. All these activities are long-term and are undertaken with the support of the PAIGH and of the IAG, on an ongoing basis, under the coordination of its Directing Council and with the participation in the Working Groups of scientists and technicians, not only from the 20 countries of Latin America and the Caribbean that comprise it, but also from international bodies, and in particular the *Deutsches Geodätisches Forschungsinstitut* (DGFI-TUM: German Institute of Geodetic Research) which is part of the Technical University of Munich (TUM) in the Faculty of Civil Engineering, Geo and Environmental (BGU).

More information: <http://www.ipgh.org>

Figure 2
Geocentric Reference System for the Americas *SIRGAS)
Organization chart



3. Regional Committee of the United Nations on Global Geospatial Information Management for the Americas (UN-GGIM: Americas)

The direct antecedent to the current configuration of the management of regional and institutional policies for the handling of geospatial information in the American continent, under the United Nations, was the creation of the Permanent Committee for Geospatial Data Infrastructure of the Americas (CP-IDEA), through which a response was given to the need to address Resolutions 3 and 4 of the Sixth United Nations Regional Cartographic Conference for the Americas (UNRCC-A)⁷ which raised the need to establish a standing committee on SDI for the Americas, national SDIs, and ensure the participation of all member countries in the Committee.

The Permanent Committee was constituted by means of an interim agreement signed by 21 countries on February 29, 2000, in Bogota, Colombia. It was agreed at the time that the Committee would promote the participation of all the countries of the Americas in the development of the Regional Spatial Data Infrastructure.

After 2013, CP-IDEA became the Regional Committee of the United Nations on Global Geospatial Information Management for the Americas (UN-GGIM: Americas). Currently, UN-GGIM: Americas comprises 38 member countries in South, Central and North America and the Caribbean, and its structure is formed by a Board of Directors consisting of a Chairman, a Vice-Chairman, an Executive Secretary and four board members. As far as possible, the board members are representative of the four American subregions mentioned above. The Regional Committee operates under the guidance of UN-GGIM, to which it presents its recommendations and respective activity reports.

The overall objective of UN-GGIM: Americas is to maximize the economic, social and environmental benefits arising from the use of geospatial information, on the basis of knowledge and exchange of experiences and technologies from different countries, based on common standards, to permit the establishment of the Geospatial Data Infrastructure of the region. This objective, and the corresponding targets, are aligned with the Global Agenda of the UN-GGIM Committee of Experts as part of a regional architecture dedicated to the management of geospatial information.

The first meeting of UN-GGIM: Americas was held on September 24 and 25, 2014 in Mexico City. The second meeting of UN-GGIM: Americas, held in Mexico City on November 11 and 12, 2015, reached the following conclusions:

- Agreement on the expiration of the format of the United Nations Regional Cartographic Conference (UNRCC) and the subsequent recommendation to the United Nations Economic and Social Council (ECOSOC) to consider the elimination of the CCRNU-A from the calendar of conferences and meetings of the United Nations, their mandates and obligations being

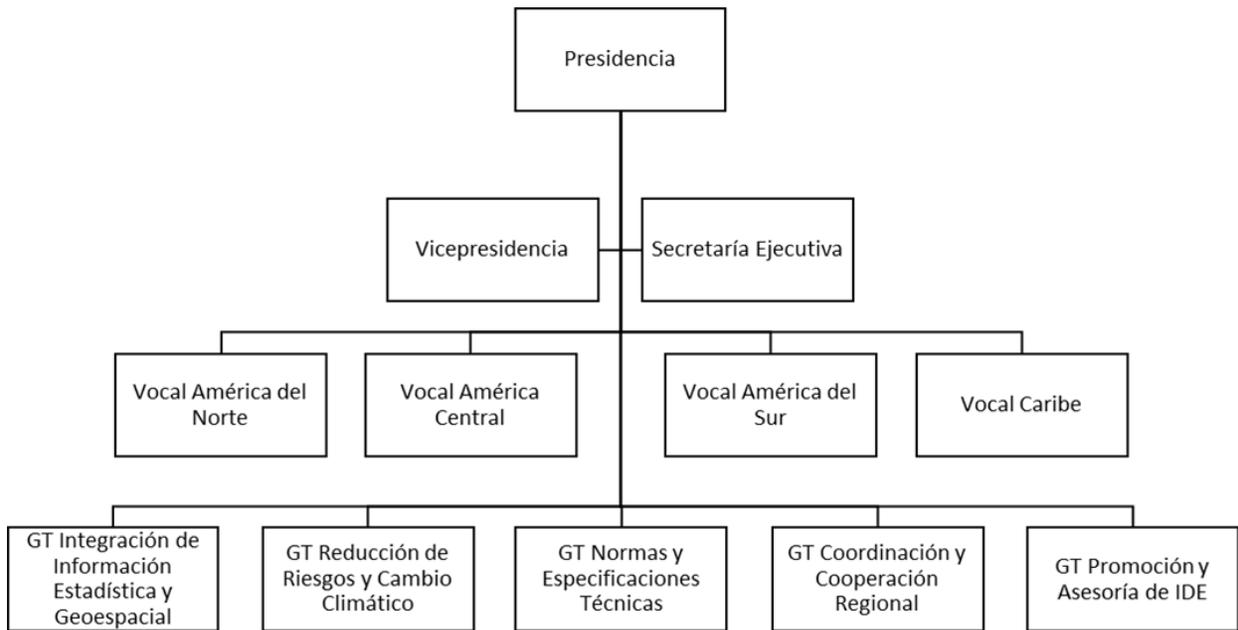
⁷ The acronym in Spanish "CCRNUA" to identify the conference is also official and appears in the statutes of UN-GGIM: Americas. However, since it is used with greater frequency, this document uses the acronym in English "UNRCC-A" to refer to the "United Nations Cartographic Conference for the Americas."

assumed by UN-GGIM at the global level, and their technical and substantive activities, at the regional and national levels, being assumed by UN-GGIM: Americas.

- Upon accepting the elimination of the CCRNU-A, UN-GGIM: Americas determined to establish mechanisms to continue addressing the cartographic agenda, using the available agreements, such as collaboration with the PAIGH and the creation of sub-working groups.
- Given the need to continue with the strengthening of the capacities of the region in the use of geospatial standards, the Executive Secretariat of the Regional Committee shall circulate to all member countries the course material from the Standards Course delivered to Caribbean countries in August 2015 by the Open Geospatial Consortium (OGC).
- The Committee agreed that the standard OGC Keyhole Markup Language (KML) will be used by members from the Americas and the Caribbean.
- The Committee thanked the members of its Working Groups for the work carried out and encouraged continued cooperation and collaboration in fulfillment of the objectives of UN-GGIM: Americas.
- The Board of Directors of UN-GGIM: Americas will work with the Coordinators of the Working Groups to streamline the format of the annual report, in order to monitor the efforts made by the region in relation to geospatial information.
- The third meeting of the United Nations Regional Committee on Global Geospatial Information Management for the Americas will take place in Mexico City in October 2016.

More information is available at: <http://www.un-ggim-americas.org>

Figure 3:
Regional Committee of the United Nations on Global Geospatial Information Management for
the Americas
(UN-GGIM: Americas)



4. CAF/PAIGH GeoSUR Program

The experience of CAF as a Development Bank demonstrates that the planning of investments in physical infrastructure projects for local economic development and for the integration of Latin America and the Caribbean requires adequate access to geospatial information that is well integrated, georeferenced and standardized. To this end, it is necessary that the information is available to planners and decision makers in a swift and simple manner, allowing both its proper usage, and its incorporation into each phase in the planning of investment projects.

In order to meet this need, in the year 2000 CAF developed the Condor Program, an initial computer tool designed to identify and warn of the principal environmental and social impacts associated with large infrastructure projects in the Andean region.

From 2007, as a further evolution of this same line of action, the initiative was taken to develop the GeoSUR Program. This program, led by CAF and the PAIGH, makes available to the public geographic information from Latin America and the Caribbean useful for planning and analyzing development activities. The web services developed or hosted by GeoSUR offer access to official maps, aerial photos and spatial data prepared by different generators of geographic information on topics such as topography, hydrology, population, population centers, environment and infrastructure, among many others.

GeoSUR provides geographic services on a web platform that allows users to obtain, locate, consult, manipulate and analyze spatial information relating to the countries of Latin America and the Caribbean. Access to these services is free, does not require the installation of special software, and has been developed with the support of the various specialized agencies, including the United States Geological Survey (USGS), the National Geographic Institute of Spain (IGN), the National Center of Geographic Information (CNIG) and several institutes of geography in the region.

Currently, the program's achievements include the development of the first regional geographic website for Latin America and the Caribbean and the entry into operation of the topographic processing service, which, as of the date of its launch, would be the first of its kind in terms of its geographical scope and high resolution. In various ways, more than 100 international, regional and national institutions are involved in the program. Today, more than 300 map services from 35 participating institutions are available for consultation on the GeoSUR website, together with more than 14,000 bibliographic entries describing the existing spatial data.

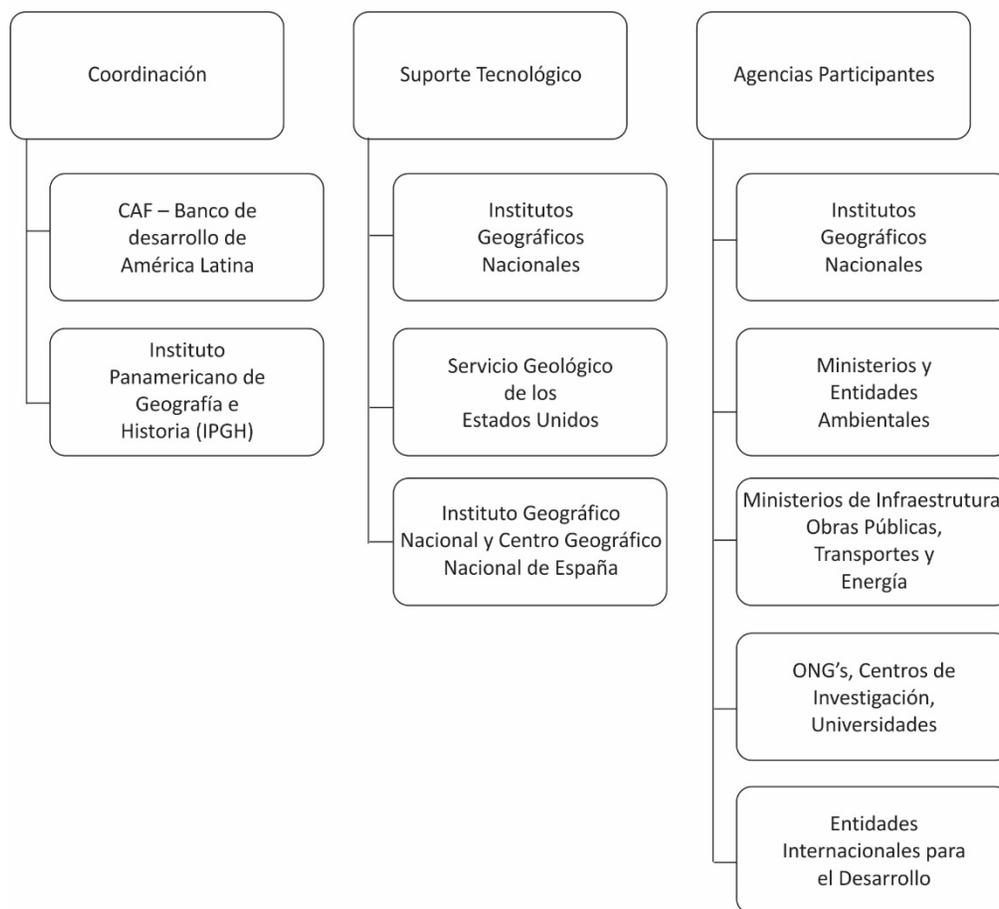
The United Nations Environment Program (UNEP) has welcomed the model implemented by the GeoSUR Program and considers it to be replicable in other regions of the world. In this regard, it

provided resources to produce a report that assessed the achievements of the program,⁸ as part of the *Eye on Earth* Summits held in Abu Dhabi in 2011 and 2015.

GeoSUR plans to expand its radius of action, through the incorporation of sectors that are currently underrepresented, such as health, education and academia. New spatial data will be incorporated into the existing regional geoservices and the functionality will be expanded to address matters of territorial organization, intelligent cities, adaptation to climate change and monitoring of forests, among others.

More information: <http://www.ipgh.org>

Figura 4
GeoSUR – La Red Geoespacial de América Latina y el Caribe
Organigrama



⁸ <<http://www.geosur.info/geosur/contents/GEOSUR%20Reporte%20Eye%20on%20Earth.pdf>>

III. COMMON SDI ELEMENTS IN THE PAIGH, SIRGAS, UN-GGIM: AMERICAS AND GEOSUR WORK PLANS

1. The interrelationship of the action plans for SDI-related initiatives from the PAIGH's perspective

From the perspective of the PAIGH, and in particular the components of its action plan entitled the "PAIGH 2010-2020 Pan-American Agenda" (Ecuador, 2009), the Institute assigns priority to the development of the regional spatial data infrastructure and its components since they are associated with the essential goals of the Agenda from a continental and multidisciplinary vision focused on regional integration, thematically focusing actions on adaptation to climate change, territorial ordering, the management of natural hazards, and historical heritage.

In this context and on the basis of a reciprocal relationship, the PAIGH, with its specialized Commissions, is interested in promoting the advancement of SIRGAS, UN-GGIM: Americas and GeoSUR since these enable it to consolidate its natural role as a means of articulating regional initiatives and a builder of capacities in the Pan-American sphere. The PAIGH has not only been directly linked to the conception, launch and development of these three initiatives but, in the case of the SDI, it has supported more than 60 related projects, with a total investment of over US\$1.5 million, such that it is the first party to be interested in avoiding duplication, in identifying projects that generate added value for the efforts made, and in carrying out a program consistent with the action plans of SIRGAS, UN-GGIM: Americas and GeoSUR, respecting the characteristics of each.

In the case of SIRGAS, its existence, supported from the outset by the PAIGH, in conjunction with the International Association of Geodesy (IAG)—initially also by the Defense Mapping Agency (DMA), currently the National Geospatial-Intelligence Agency (NGA)—corresponds to an activity directly related to the development of SDIs in the region, which is essential in the sense of providing it with the geodetic framework essential for the georeferencing of geospatial data.

SIRGAS is a clearly multinational initiative. Its work program is focused on the development and maintenance of the high precision vertical reference system, comprising the national, continental and global scales, as well as the implementation and maintenance of the geocentric reference frame in each country of the region, which are decisive for improving the positional accuracy and quality of the other geospatial data.

With regard to capacity building, SIRGAS implements its work plans with an emphasis on training activities, in an ongoing and persistent manner, in the form of seminars, schools and workshops aimed at the production, dissemination and maintenance of geodetic data and information. Since 1995 the PAIGH has supported projects relating to SIRGAS via a direct contribution of over US\$120,000 and a total value of more than US\$280,000 including counter payments.

In relation with the GeoSUR Program, developed as part of a collaborative effort by the CAF and the PAIGH, as the Geospatial Network for Latin America and the Caribbean, their work plans directly contribute to the implementation of the Institute Agenda and, in particular, facilitate

access to and application of the fundamental spatial databases available in the region, capacity-building in the institutions responsible for national cartography in their human resources training processes and the functional and technological modernization. In addition, in the process of their implementation, they have acquired importance structural issues from the SDIs, such as the application of international standards and the consolidation of geospatial metadata catalogs.

In regard to UN-GGIM: Americas, beyond the financial contribution made by the PAIGH for the establishment of its predecessor, CP-IDEA, on the basis of considering important the setting up of a technical committee for the development of SDIs in the region, the proposed collaboration is of the greatest importance not only because of the evident complementarity, but primarily because of the generation of economies of scale resulting from the avoidance of existing duplication both in the destination of human resources and in the activities and results. In the region there are many projects both completed and underway that would benefit from the implementation of the UN-GGIM: Americas program, taking as a reference to what has already been achieved in the field of standards, analysis of the institutional framework and specific applications.

By way of example, in 2010 the ISO and the PAIGH published the first edition of the *Guide to Standards ISO TC/211* in Spanish, which is freely available on the website of the latter. Meanwhile, the "Group for the Harmonization of Norms and Standards" arising from the R3IGeo collaboration, published a second edition in 2013.

This background is related with the proposal made by the Working Group on Standards and specifications of UN-GGIM: Americas concerning "maintaining a set of standards and technical specifications that are applicable to the region as a whole, beyond national specificities." In effect, this target cannot be taken as starting from scratch, but must collect the work carried out by other organizations and on this basis show consistency with existing international standards.

Similarly, the PAIGH and CAF through GeoSUR have defined a strategy to achieve the establishment of a continental integrated digital cartography in the medium term. This is the case of the projects Integrated Map of Central America, Integrated Map of the Northern Andes, and Integrated Map of South America.

On the basis of these experiences, it is noted that the construction of the data infrastructure in the region corresponds to a dynamic process that is undergoing evolution and that is not controlled from above. It is the result of practices, concepts and projects developed by academia, consultants, industry, national actors and specialized institutes.

2. The interrelationship of the action plans for SDI-Related Initiatives from the perspective of the PAIGH

The institutional frame of SIRGAS is based on two complementary paradigms: that established by the IAG for its "Global Geodetic Observation System (GGOS)" and that defined by the PAIGH in its "2010-2020 Pan-American Agenda." The former expresses the international scientific and technological vanguard in the field of geodesy for the monitoring of the Earth system and climate change research, while the second places the emphasis on the use of the knowledge and technologies of geodetic base to improve the territorial ordering of the region.

Within this context, SIRGAS is visualized as a bridge that, crossed in one direction, promotes the participation of the region in the international geodetic scene, and in the opposite direction, ensures that the latest scientific knowledge is transformed into concrete solutions to the problems of geodetic databases raised by the region.

The PAIGH has supported SIRGAS continuously from its origins as a Pan-American initiative since 1993. Such support has been materialized in two complementary and equally relevant ways: through regular subsidies applied almost exclusively by SIRGAS in facilitating scientific and academic exchanges, which have benefited numerous institutions in almost all the countries of Latin America and more recently in the Caribbean; and through sustained intellectual support for the interaction between SIRGAS and the geography institutes and other governmental agencies of the Pan-American community.

Such support has been key to turning SIRGAS into the main forum for discussion and the main agent of dissemination of the progress of Geodetics in Latin America and the Caribbean (the annual symposia, schools and workshops attract on average nearly two hundred participants), as the central point of focus for geodetic activity carried out by the geographic institutes and other agencies in the region.

Below is a brief digression that will provide conceptual support for the type of relationship that SIRGAS conceived with the sister initiatives of UN-GGIM: Americas and GeoSUR. It is difficult to avoid the temptation to use an image of stacked layers when it comes to creating a logo that identifies an SDI. But this image, which summarizes so well the fundamental concept of the SDI, says nothing about how to align the layers so that they consistently overlap one another. It is often said that that is achieved with georeferencing, but although necessary, this condition is insufficient to ensure the alignment of the layers. It is also essential that the georeferencing of all layers is undertaken with regard to a single reference frame which constitutes the fundamental layer of the SDI. This reference framework for Latin America and the Caribbean is provided by SIRGAS.

SIRGAS coordinates the efforts of more than 50 institutions in 20 countries to provide products, data, knowledge and services for georeferencing the SDI for the Americas. The main product offered by SIRGAS is a reference framework able to withstand all the demands of a SDI (from low accuracy georeferencing for the purpose of mapping, to the millimetric positioning required to study global change). With its more than 400 continuous observation GNSS stations, through member countries SIRGAS provides data that facilitate georeferencing, including real-time applications. SIRGAS promotes the permanent updating of the communities that generate and use geospatial information through activities ranging from the preparation of standards and technical specifications to the delivery of training courses. In addition to all this, the SIRGAS

analysis centers produce maps that describe tectonic activity, atmospheric variability or variations in sea level, all necessary products for the understanding of global change.

Meanwhile, in the global scope of UN-GGIM the Working Group on the Global Geodetic Reference Frame for Sustainable Development (GGRF) has been consolidated, of which SIRGAS plays an active part. The working group is now moving to consolidate its road map and holds the first geospatial resolution of the General Assembly of the United Nations (A/RES/69/266 of February 26, 2015) which recognizes the importance of a coordinated and comprehensive approach to geodetics, in virtue of the role that this discipline plays in daily life, from the use of smart phones to poverty reduction.

Based on these considerations, SIRGAS is a key provider of inputs and knowledge that is useful and indispensable for UN-GGIM: Americas and GeoSUR to fulfill their mandates. From a reciprocal perspective, SIRGAS needs UN-GGIM: Americas and GeoSUR to contribute to generating consensus on its use (or the equivalent, the national frames of reference that densify SIRGAS) as a single reference framework for SDI in the Americas. The creation of such a consensus ranges from the preparation of recommendations, standards and technical specifications, to the articulation of a very clear message of support to SIRGAS as the single system of reference to ensure the maximum utilization of the SDI for the Americas.

3. The interrelationship of the action plans for SDI-Related initiatives from the UN-GGIM: Americas' perspective

As a result of the review of the institutional frameworks of the four regional initiatives, contained in Chapter II of this document, the vision of UN-GGIM: Americas consists in that they contribute to the development of the SDI in the Americas and in the national processes of implementation of their infrastructure, from their specific areas of action.

Each of the programs and initiatives which contribute to the formulation of this joint work plan is linked to one or more components of an SDI (hereinafter marked in **bold**). Around these are identified, on the one hand, very well defined plots (complementary to each other, which is very important) and some themes which need to foster collaborative work to achieve synergies from the individual contributions.

In consideration of the mission, objectives and ongoing activities mentioned in chapter II, it can be observed that in the case of the PAIGH it is strongly linked to the development of the **data context** of the countries in the region, supporting the consolidation of the fundamental geospatial databases, advising the modernization programs of the National Geographic Institutes in these matters, promoting research, promoting cooperation between the specialized institutions, with special attention to the continent's cartographic integration processes. Similarly, the PAIGH focuses on the themes of interoperability through the implementation of **standards** and the promotion of training of **human resources**.

GeoSUR provides the **distribution platform** to facilitate access to and use of geospatial information through regional geographical services to obtain, locate, consult, manipulate and analyze the information from Latin American countries. Its scope of action extends at present toward Central America and the Caribbean. In this perspective, GeoSUR could be extended to all

countries of the continent, collecting relevant data sets from the portals of Canada and the United States.

For its part, SIRGAS makes a very important contribution to the development of the **data framework** of the region, through its objective to realize and maintain the system and the three-dimensional geocentric frame of reference of the Americas in order to provide and maintain the fundamental layer of SDIs in the continent.

While the goals and current activities of UN-GGIM: Americas are focused on the promotion and strengthening of SDI in the field of **legal framework, policies and plans, capacity-building and standards** through the dissemination of best practices, the publication of technical documents, implementation of the Web platform and the monitoring of member countries with regard to the progress experienced in each of the SDI components mentioned previously.

A special line of work in this area is materialized through the project aimed to strengthen the Spatial Data Infrastructures in the countries and territories of the Association of Caribbean States, through the construction of capacities, including the acquisition of infrastructure for the strengthening of the geodetic network with the delivery of equipment for stations and field, as well as training in its use and to provide support for the development of a land cover map based on data from remote sensors and the creation of a Geomatics solution in the Caribbean.

On the other hand, UN-GGIM: Americas is developing an agenda to promote and encourage the production of quality geographical and statistical information, as well as the identification, development and implementation of strategies for its integration and use through partnerships, cooperation and participation of member countries, in line with the progress of UN-GGIM global.

Another significant aspect of the work plan of UN-GGIM: Americas is to promote the use of geospatial information to support the ability of Member States to cope with natural disasters, a matter which is of vital importance in consideration of the frequency with which natural phenomena occur that affect the population, infrastructure and productive systems.

In virtue of what is set out in the preceding paragraphs, the opinion of UN-GGIM: Americas is that the joint work plan should be used to enhance the roles and functions that each of the four organizations or regional initiatives are developing: PAIGH and SIRGAS, through work with the National Geographic Institutes, focusing on the provision of basic standardized geospatial databases, referred to a unique reference system and satisfying the objectives of quality, compatibility and interoperability; GeoSUR, enhancing the geoportal of the Americas, expanding the network of services and the diversity of layers of information of the countries of the region, through an expeditious coordination supported by PAIGH and UN-GGIM: Americas, supporting and following-up the national processes in all the components of SDIs, promoting the exchange of information between countries and promoting its use for decision-making at the national, regional and global levels, in the context of the UN.

Meanwhile, the themes common to the management of these four organizations or regional initiatives, under the philosophy of UN-GGIM: Americas, which require the planning of coordinated, integrated and complementary work, are those related with interoperability (norms, standards and technical specifications) and capacity-building and training of human resources. Here there is a need for a detailed review of the existing work plans and to develop a

new proposal leading to the optimization of the contributions of each one, maximizing the use of resources and the achievement of better results for the benefit of all countries in the Americas and the Caribbean.

4. The interrelationship of the action plans for SDI-Related initiatives from the GeoSUR's perspective

The GeoSUR Program presents a clear complementarity with the initiatives advanced by SIRGAS, UN-GGIM: Americas and PAIGH in their respective plans of action, outlined above. The CAF is interested in enhancing this complementarity and contributing to laying the foundations of a large-scale regional data infrastructure.

There are clear synergies between GeoSUR and UN-GGIM: Americas, especially in areas of common interest such as training, inventory of spatial information and implementation of standards and protocols, as well as the adequate involvement of the national SDIs with the regional level. It is considered that UN-GGIM: Americas has the ability to strengthen the action of GeoSUR through effective coordination with the national and sub-national SDIs in Latin America and the Caribbean.

For its part, GeoSUR offers UN-GGIM: Americas a practical mechanism for the testing and deployment of regional standards and protocols in geoservices and other geospatial applications. Both initiatives have the ability to boost the development of functional applications aimed at decision-makers and the public, that enhance the notion of the SDI as a key factor—and a source of reliable information—for development in our region.

Together with SIRGAS, GeoSUR has the capacity to promote the use of the continental reference system as an integral component in the implementation of tools and geoservices by the institutions that participate in GeoSUR. There is also the possibility of assessing the relevance of incorporating basic information provided by SIRGAS in topics such as geodesy, atmosphere and terrestrial dynamics in the GeoSUR platform and associated national geoservices.

The PAIGH and CAF, in their capacity as coordinating institutions of GeoSUR, have been carrying out multiple joint actions with the CAF since 2007, year of the launch of GeoSUR in Brasilia. The PAIGH has supported with enthusiasm and effectiveness the involvement of the region's institutes of geography in this initiative and has implemented its conceptualization, planning and entry into operation. This working relationship has been consolidated and enhanced with the new plan of action of the GeoSUR Program, which is currently running.

As is clear from the information provided, GeoSUR maintains clear links and complementarity with the scope of action of the PAIGH, SIRGAS and UN-GGIM: Americas, which, in order to achieve greater effectiveness, merit a closer relationship and coordination. Meanwhile, GeoSUR maintains links of cooperation with regional and global initiatives that can enhance the global insertion of the regional SDI for Latin America and the Caribbean. The institutions and initiatives it has been working with include:

Joint Plan of Action 2016-2020 to Accelerate the Development of SDI in the Americas

- The Andean Community of Nations (CAN, in Spanish), in the framework of the Regional Amazonian Environmental Information Platform (PIRAA).
- The *Eye on Earth* Platform.
- The Infrastructure for Spatial Information in the European Community (INSPIRE).
- The Initiative for the Integration of the Regional Infrastructure of South America (IIRSA, in Spanish), backed by the Union of South American Nations (UNASUR, in Spanish).
- The National Geographic Institute and the National Center for Geographic Information, Spain.
- The Association for the Global Spatial Data Infrastructure (GSDI).
- The Association of European Agencies for Mapping, Cadastral and Land Registry (*Eurogeographics*).

Finally, it is important to highlight the role that the CAF can play to promote the consolidation of the SDIs at the regional, national and local levels. In its role as a development bank, owned by a significant number of countries of the region, the CAF not only acts as a project funder, but also plays a major role both as an institutional broker and user of spatial information. The CAF can support the PAIGH, SIRGAS, UN-GGIM: Americas and GeoSUR in the implementation of practical, high-impact actions that have a positive impact on informed decision-making processes, as well as the promotion of early insertion of the geospatial aspects—or spatial enabling—of development projects.

IV. 2016-2020 JOINT ACTION PLAN

The Action Plan that the bodies participating in this effort propose to carry out in a joint manner should result in significant momentum to the development of the SDI initiatives in the region, and an important contribution to the access and use of geospatial information in the Americas. In its original version (Buenos Aires, 2012), the Plan represented the starting point for drawing up a cooperation road map for the bodies' shared aims, which is added to as new initiatives and forms of collaboration are identified.

Table 1.
Essential competencies that characterize the key SDI initiatives and potential areas of contribution to joint work

<i>Body and instrument for action</i>	<i>Potential areas of contribution</i>
<p>PAIGH 2010-2020 Pan American Agenda (scientific strategy of the PAIGH)</p>	<ul style="list-style-type: none"> • Integrated Pan American Map Project • Cooperation between key SDI institutions and initiatives • Consolidation of framework databases • Capacity-building • Geospatial Data Standards and Interoperability • Technical Publications
<p>SIRGAS Annual Work Plan</p>	<ul style="list-style-type: none"> • Development and maintenance of the SIRGAS reference frame • Contribution to the measurement and analysis of the Earth system • SIRGAS activities in real time • Practical applications aimed at the adoption of SIRGAS at sub-regional and national levels • Definition and implementation of a vertical reference system • Capacity-building through the training of human resources • Contribute to the regional implementation of the road map of the Global Geodetic Reference Frame for Sustainable Development • Technical Publications
<p>UN-GGIM: Americas Four-Year Work Plan</p>	<ul style="list-style-type: none"> • Development of the legal framework, policies and plans essential for SDI • Strengthening of human resources and dissemination of good practices • Integration of geospatial and statistical information • Monitoring of advances made by each country in each component of SDI • Coordination with the national and sub-national SDIs in the region
<p>GeoSUR Three-Year Action Plan</p>	<ul style="list-style-type: none"> • Consolidation of a Geoportal to facilitate access to and use of regional geospatial information • Support for capacity-building for technological innovation in SDI (CAF) • Support for the generation of base and thematic maps that are

	homogenized and standardized at regional level (Central and South America)
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In practice, it is a question of matching, as far as possible, the PAIGH's 2010-2020 Pan American Agenda, the Work Plan of SIRGAS, the Work Plan of UN-GGIM: Americas and the Action Plan of GeoSUR. To establish the components of the Plan, it is important to summarize the proposals arising from the previous chapter, containing the existing visions of each participating body. Table 1 contains the list of elements proposed by the bodies for the elaboration of the Action Plan.

1. Proposals by the PAIGH

- Carry out Joint Working Days between PAIGH, SIRGAS, UN-GGIM: Americas and GeoSUR.
- Develop workshops on “management capacity-building in national institutions responsible for spatial data, geographic information services and Spatial Data Infrastructures,” in partnership with the National Geographic Institute (IGN) of Spain and other agencies.
- Through the PAIGH's annual Technical Assistance Program, provide priority support for projects properly aligned with the present Joint Action Plan.
- Connect SIRGAS, UN-GGIM: Americas and GeoSUR to the current effort carried out by the PAIGH and R3IGeo to debug the harmonized terminology of the ISO standards in Spanish for the second edition of the ISO TC/211 Standards Guide.
- Continue to promote the Draft Integrated Pan-American Map in coordination with GeoSUR and in partnership with CNIG of Spain and USGS, as well as with the institutes of geography of the countries of the region, SIRGAS and UN-GGIM: Americas, in order to have continuous geographic information at a scale of 1:250,000 at the continental level.
- Promote the development of virtual training in topics related to the generation of geospatial information, SDIs, environmental management indicators and others, in coordination with agencies such as CNIG, GeoSUR, UNEP, *Eye on Earth*, USGS and others.
- Promote, in conjunction with UN-GGIM: Americas and GeoSUR an initiative to integrate statistical and geographic information through the development, implementation and maintenance of the Statistical and Geospatial Framework for the Americas (MEGA), in order to enable the analysis of socio-economic and environmental problems and those relating to regional or cross-border natural disasters.
- Promote actions with GeoSUR and UN-GGIM: Americas oriented towards the systematic economic evaluation of the benefit of SDI initiatives at the national level through cost/benefit studies.
- Promote, in coordination with GeoSUR, CNIG of Spain, USGS and the National Sections of the Member States of the PAIGH, the use and continual updating of the Latin American Metadata Profile (LAMP).
- Recommend participation in the ISO TC/211 Technical Committee to PAIGH Member States.
- Promote the development of virtual courses in coordination with specialized agencies.

2. Proposals by the SIRGAS

In addition to endorsing the proposals formulated by the PAIGH, SIRGAS proposes the following specific actions to be executed in the framework of this joint work plan:

- Holding annual SIRGAS Workshops and Symposia to support the consolidation of the national SDIs and US-GGIM: Americas.
- Develop the "Interface for the exchange of information between PAIGH, UN-GGIM: Americas, GeoSUR and SIRGAS", consisting in a jointly prepared technical paper, which will specify the formats and protocols for the exchange of data and products common to the four initiatives.
- Contribute to the regional implementation of the road map of the Global Geodetic Reference Frame for Sustainable Development (GGRF), as well as Resolution A/RES/69/266 of the General Assembly of the United Nations on the GGRF.
- Develop, in conjunction with UN-GGIM: Americas and the PAIGH, the recommendations and technical documents required to promote consensus on the use of this system of reference at the level of institutions that lead SDIs in the member countries.

3. Proposals by the UN-GGIM: Americas

The work plan of UN-GGIM: Americas is presented in the following proposals:

- Harmonize the training plan of UN-GGIM: Americas with the training activities planned in the context of the action plans of PAIGH, SIRGAS and GeoSUR.
- In relation to norms, standards and technical specifications, UN-GGIM: Americas proposes to define the functionality, structure and maintenance procedures of the "Bank of Standards," accessible from the web site of UN-GGIM: Americas, to create a platform that allows ordered and systematic access to the documentation generated by the four organizations.
- Prepare and document a procedure for the publication of technical documents and good practices generated and gathered by the four organizations in the SDI Observatory of the UN-GGIM: Americas web site.
- Generate, in collaboration with the PAIGH, the structural proposal of the Statistical and Geospatial Framework for the Americas (MEGA), which allows the integration of statistical and geospatial information and its localization using recognized geocoding methods.
- Develop, in conjunction with the PAIGH, a strategy to promote the coordinated and collaborative work of the institutes of geography and the agencies in charge of the implementation of the national SDIs of member countries of UN-GGIM: Americas.
- Prepare, together with SIRGAS, the recommendations and technical documents required to promote consensus on the use of this system of reference at the level of institutions that lead SDIs in the member countries.

- Disseminate events and meetings related to the work of the four organizations on the web site of UN-GGIM: Americas and develop a procedure to keep this information up to date.

4. Proposals by GeoSUR

- Carry out virtual training workshops on metadata management and implementation of visualization services (in partnership with the CNIG in Spain, the USGS, UN-GGIM: Americas and PAIGH).
- Incorporate the spatial data from SIRGAS into the portal and the GeoSUR regional viewer as a fundamental regional base layer.
- Integration of the GeoSUR platform into regional and global initiatives such as the Committee of Experts of the UN for Global Geospatial Information Management (UN-GGIM), the Global Earth Observation System of Systems (GEOSS), *Global Network of Networks*, *Eye on Earth*, *Eurogeographics* and the Infrastructure for Spatial Information in the European Community (INSPIRE).
- Continue to support the Integrated Pan-American Map initiative in coordination with the PAIGH and in partnership with the CNIG in Spain, USGS and the institutes of geography of the respective countries.

List of Acronyms

CAF	The Development Bank of Latin America (Andean Development Corporation)
CAN	Andean Community of Nations
CCRNU-A	United Nations Regional Cartographic Conference for the Americas
CP-IDEA	The Permanent Committee for the Geospatial Data Infrastructure for the Americas
DGFI	Deutsches Geodätisches Forschungsinstitut (Germany)
FIG	International Federation of Surveyors (Fédération Internationale des Géomètres)
GEOSS	Global Earth Observation System of Systems
GeoSUR	Geospatial Network for Latin America and the Caribbean.
GGIM	United Nations Initiative on Global Geospatial Information Management
GNSS	Global Navigation Satellite System
GSDI	Global Spatial Data Infrastructure Association
GTplan	Planning Working Group (Grupo de Trabajo de Planificación)
IAG	International Association of Geodesy
IAGA	International Association of Geomagnetism and Aeronomy
IASPEI	International Association of Seismology and Physics of the Earth's Interior
ICA	International Cartographic Association
IDB	Inter-American Development Bank
IGDN	Inter-American Geospatial Data Network
IGN	National Geographic Institute (Instituto Geográfico Nacional)
IIRSA	Integration of Regional Infrastructure in South America (Integración de la Infraestructura Regional Suramericana)
INSPIRE	Infrastructure for Spatial Information in the European Community
ISO	International Organization for Standardization
ISPRS	International Society for Photogrammetry and Remote Sensing
IUGG	International Union of Geodesy and Geophysics
LAGF	Latin America Geospatial Forum
OAS	Organization of American States
OGC	Open Geospatial Consortium
PAIGH	Pan-American Institute of Geography and History
PIRAA	Regional Amazonian Environmental Information Platform (Plataforma de Información Regional Ambiental Amazónica)
SDI	Spatial Data Infrastructure
SIRGAS	Geocentric Reference System for the Americas
UNASUR	Union of South American Nations (Unión de Naciones Suramericanas)
UNEP	United Nations Environment Program
UN-GGIM: Americas	Regional Committee of United Nations Global Geospatial Information Management for the Americas
UNRCC-A	United Nations Regional Cartographic Conference for the Americas
USGS	United States Geological Survey
WB	World Bank

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Joint Plan of Action 2016-2020 to Accelerate the Development of SDI in the Americas

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