

Geocentric Reference System for the Americas

4th Session UN-GGIM Americas

April 2017, Santiago, Chile



María Virginia Mackern

Vicepresidente SIRGAS

Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina

Universidad Nacional de Cuyo, Mendoza, Argentina

Universidad Juan Agustín Maza, Mendoza, Argentina



William Martínez

Presidente SIRGAS

Agencia Nacional de Minería, Bogotá, Colombia



UN-GGIM: Américas

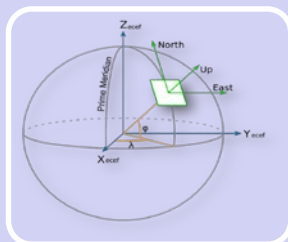
COMITÉ REGIONAL DE LAS
NACIONES UNIDAS SOBRE
LA GESTIÓN GLOBAL
DE INFORMACIÓN GEOESPACIAL
PARA LAS AMÉRICAS

Con apoyo de:



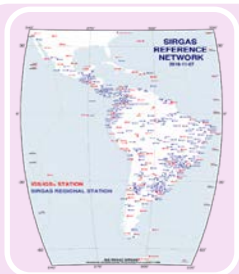
International
Association of
Geodesy

- Definitions and Brief history
- **SIRGAS in numbers today**
 - 1-SIRGAS Reference Frame
 - 2-SIRGAS: National datums
 - 3-SIRGAS: Unified heights
- SIRGAS in the UN-GGIM context
- **Next events 2017 and 2018**



SIRGAS stands for The Geocentric Reference System for the Americas.

It is identical to the International Terrestrial Reference System (ITRS).



It is the definition, realization and maintenance of the 3D geocentric reference system. Its realization is a regional densification of the global International Terrestrial Reference Frame (ITRF).



It defines and maintains the gravity field-related vertical reference system in the Americas region.



The extension of the SIRGAS frame is carried out by national densifications, which serve as local reference frames.



It is a member of the IAG Commission 1 (Reference Frames)



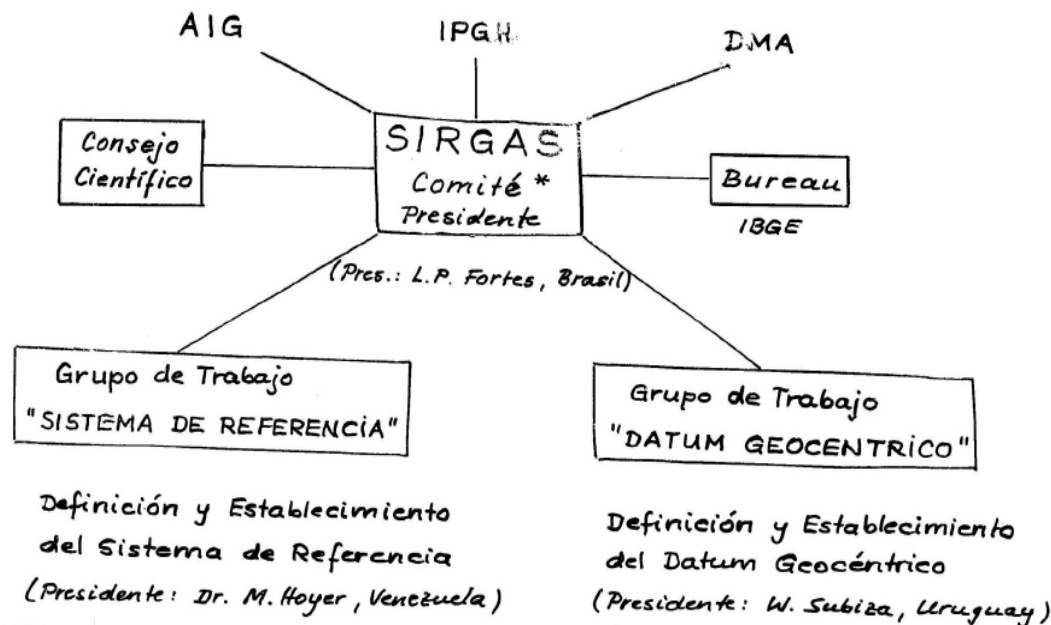
It is a Working Group of the Cartographic Commission of the Pan-American Institute of Geography and History (PAIGH)



24 years ago

Asunción 1993

**International Conference
for definition of the
Geocentric Datum for
South America**



SIRGAS Grupo de Trabajo "SISTEMA DE REFERENCIA"
Estaciones pre-existent



Propósito para el número de estaciones GPS por país

Argentina	6	(2.78 Mill. km ²)
Brasil	10	8.51
Bolivia	4	1.10
Chile	4	0.76
Colombia	4	1.14
Ecuador	3 (incl. Galapagos)	0.28
Guayana	1	0.21
Guayana Franc.	1	0.09
Paraguay	2	0.41
Peru	4	1.29
Suriname	1	0.16
Uruguay	2	0.18
Venezuela	4	0.91
Países de Islas	2	
en total	48	~ 18 Mill. km²

1993

**Definition
WG-I + WG-II**

1995

**First GPS
Campaign**

1997

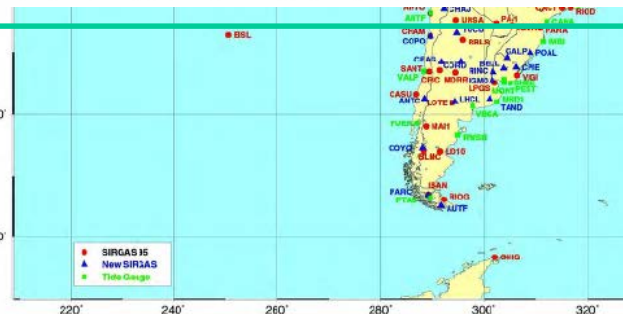
**Definition
WG-III**

2000

**Second GPS
Campaign**

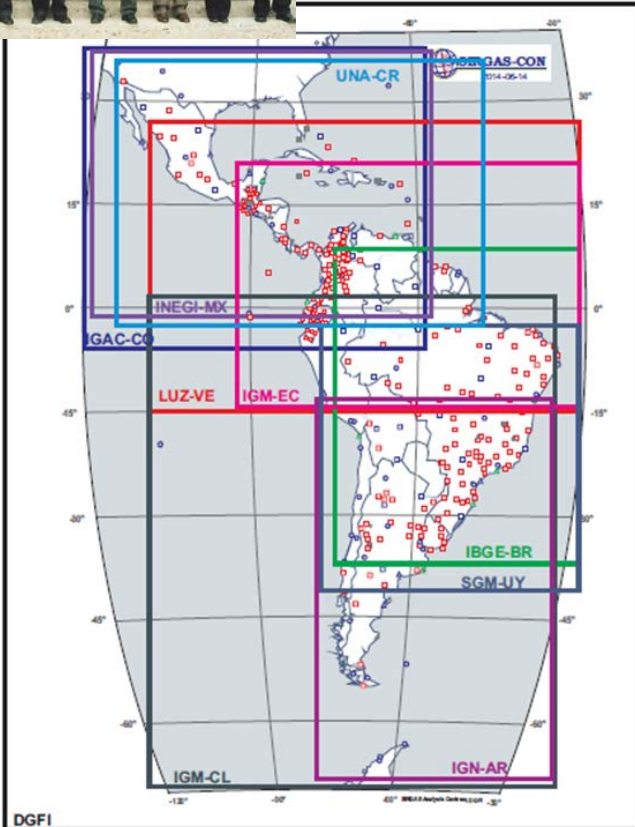
2001

**7th UN Regional Cartographic
Conference for the Americas,
New York, USA**



- **Recommends** that member countries of the Americas integrate their national geodetic reference systems into a reference system compatible with SIRGAS;
- **Also recommends** that member countries of the Americas provide to SIRGAS gravity data for computation of the geoid as the reference surface of the vertical (height) system;
- **Further recommends** that member countries of the Americas correct their leveling by gravimetric observations in order to compute geopotential numbers and connect the leveling networks with neighboring countries, making all these information available to SIRGAS.

- **Also bearing in mind** that SIRGAS is supporting the participating countries in terms of knowledge transfer and training;
- **Recommends** that member countries of the Americas integrate their national geodetic reference systems into a reference system compatible with SIRGAS;
- **Also recommends** that member countries of the Americas provide to SIRGAS gravity data for computation of the geoid as the reference surface of the vertical (height) system;
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CEPGE-Ec



IGN-Ar



IGM-CI



INEGI-Mx



IGAC-Co



SGM-Uy



DGFI TUM



IBGE-Br



CNPDG-Cr



CPAGS-Ve



UNLP-Ar



CIMA-Ar



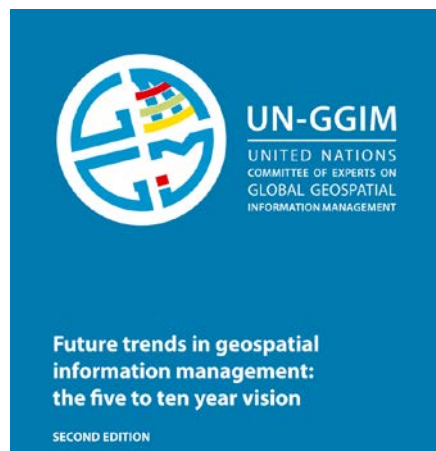
2012
Joint Action Action

2014
Working Group on the Global Geodetic Reference Frame GGRF of the UN-GGIM

2016
Joint Action Plan V. 2

IPGH + SIRGAS+CP-IDEA + GEOSUR 2013-2015 JOINT ACTION PLAN

to expedite the development of Spatial Data infraestructura of the Americas



IPGH + SIRGAS+ + UN-GGIM: Americas + GEOSUR 2016-2020 JOINT ACTION PLAN



To represent the Americas region in the WG on the UN-GGIM GGRF



The Pan American Institute of Geography and History (IPIGH)
The Geocentric Reference System for the Americas (SIRGAS)
The Permanent Committee on Spatial Data Infrastructure for the Americas (CP-IDEA)
The CAF/PAIGH Geospatial Network for Latin America and the Caribbean (GeoSUR)

2013-2015 JOINT ACTION PLAN TO EXPEDITE THE DEVELOPMENT OF SPATIAL DATA INFRASTRUCTURE OF THE AMERICAS

Santiago Borrero, Secretary General, PAIGH
Claudio Brunini, Presidente, SIRGAS
Luz Paulo Souto Fortes, Presidente, CP-IDEA
Eric van Praag, Regional Coordinator, GeoSUR

Instituto Panamericano de Geografía e Historia (IPIGH)
Sistema de Referencia Geocéntrico para las Américas (SIRGAS)
Comité Permanente para la Infraestructura de Datos Geoespaciales de las Américas (CP-IDEA)
Red Geoespacial de América Latina y el Caribe CAF/IPGH-GeoSUR

PLAN DE ACCIÓN CONJUNTO 2013-2015 PARA ACCELERAR EL DESARROLLO DE LA INFRAESTRUCTURA DE DATOS ESPACIALES DE LAS AMÉRICAS

Santiago Borrero, Secretario General IPGH
Claudio Brunini, Presidente SIRGAS
Luz Paulo Souto Fortes, Presidente CP-IDEA
Eric van Praag, Coordinador Regional GeoSUR



Instituto Panamericano de Geografía e Historia (IPGH)
Sistema de Referencia Geocéntrico para las Américas (SIRGAS)
Comité Regional de las Naciones Unidas sobre la Gestión Global de Información Geoespacial para las Américas (UN-GGIM: Américas)
Programa CAF/IPGH GeoSUR

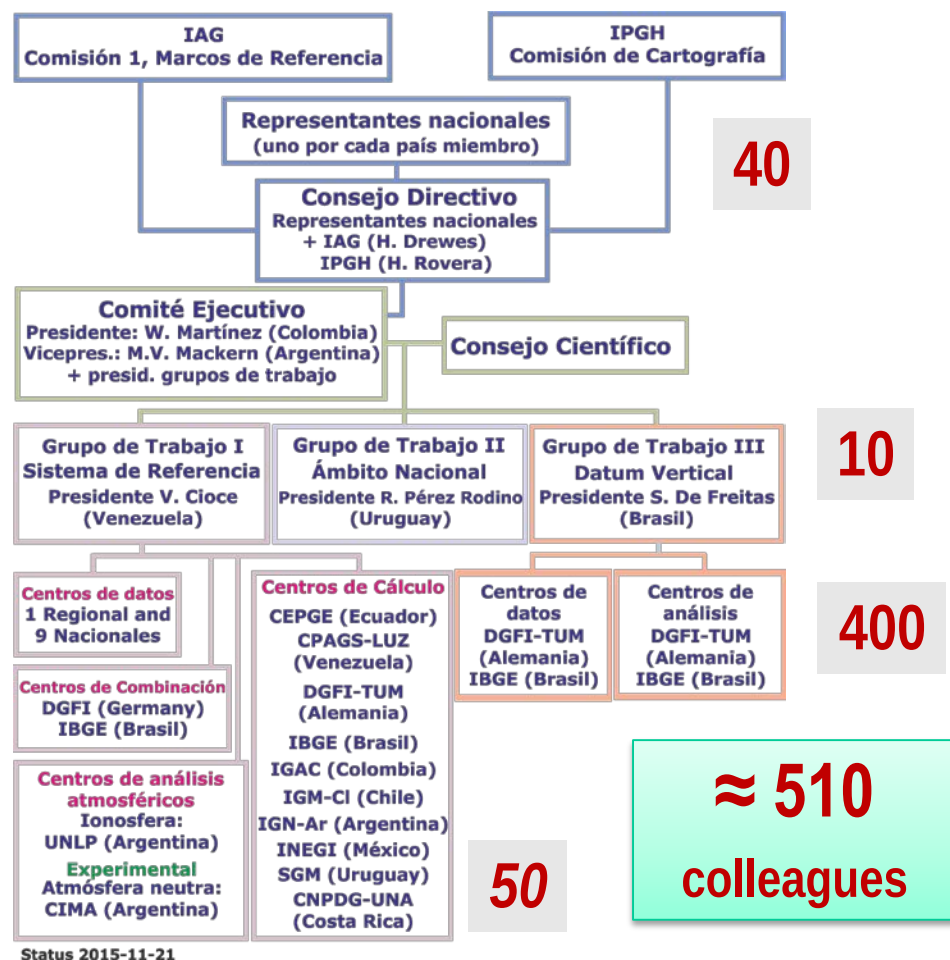
PLAN DE ACCIÓN CONJUNTO 2016-2020 PARA ACCELERAR EL DESARROLLO DE LA INFRAESTRUCTURA DE DATOS ESPACIALES DE LAS AMÉRICAS

Rodrigo Barriga Vargas, Secretario General IPGH
William Martínez Díaz, Presidente SIRGAS
Rolando Ocampo Alcántar, Presidente UN-GGIM: Américas
Santiago Borrero Mutis, Coordinador Regional GeoSUR



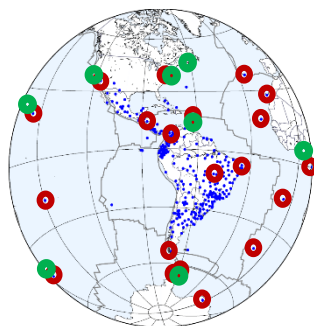
SIRGAS coordinates the largest geodetic infrastructure in Latin America and the Caribbean.

More than 50 institutions from 20 countries

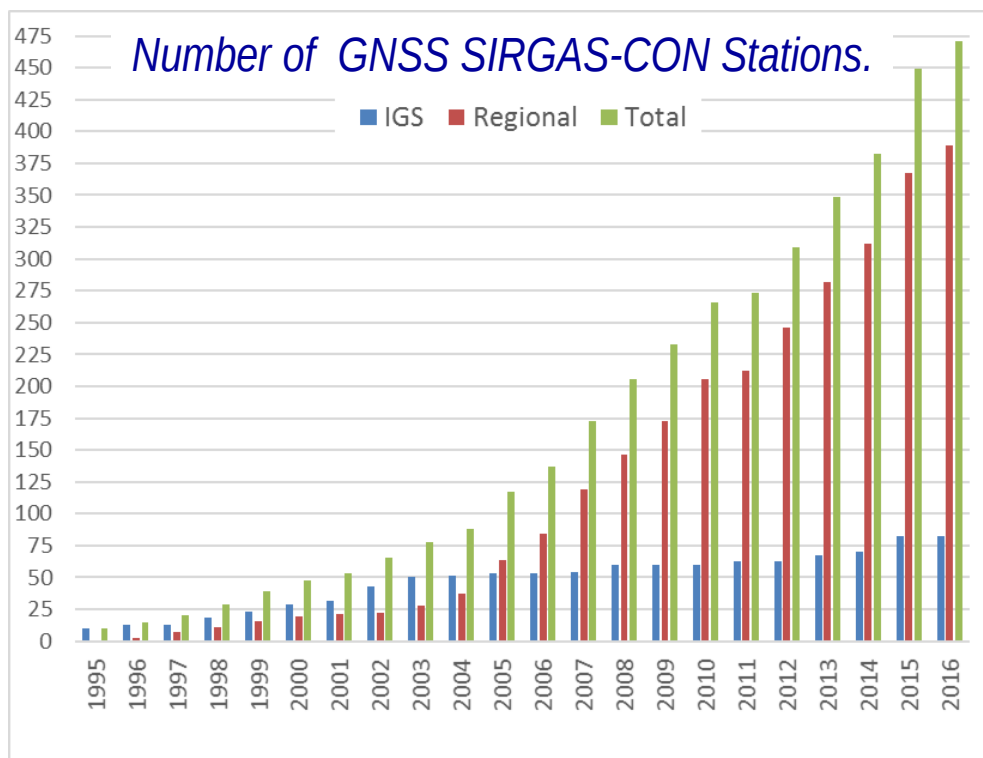
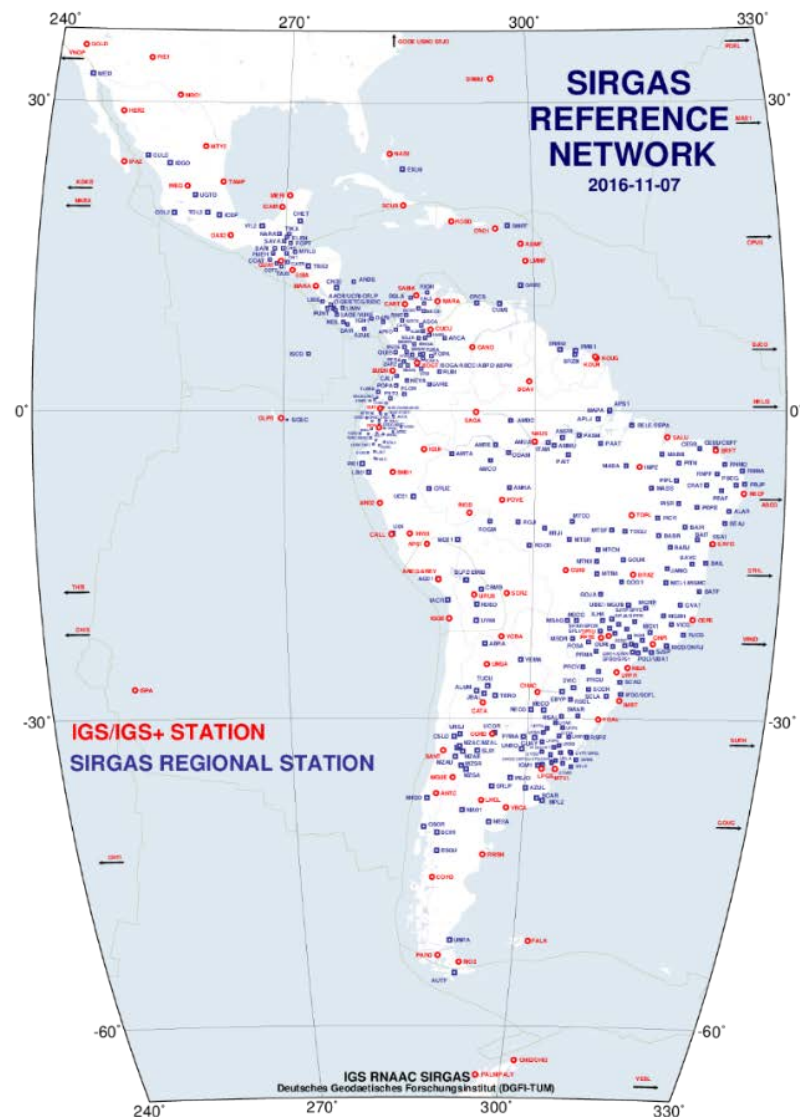
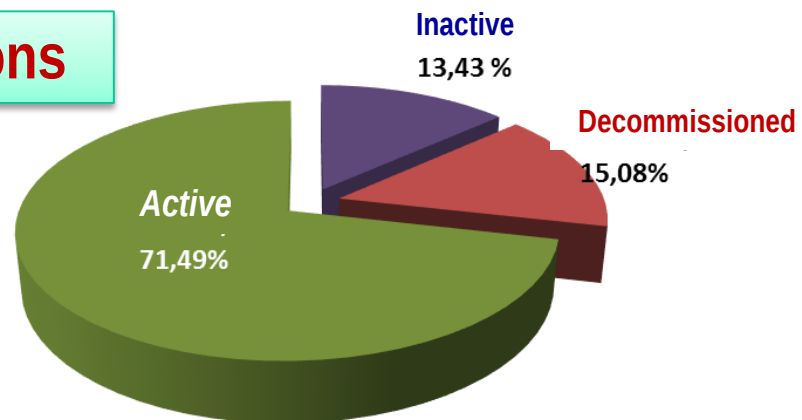


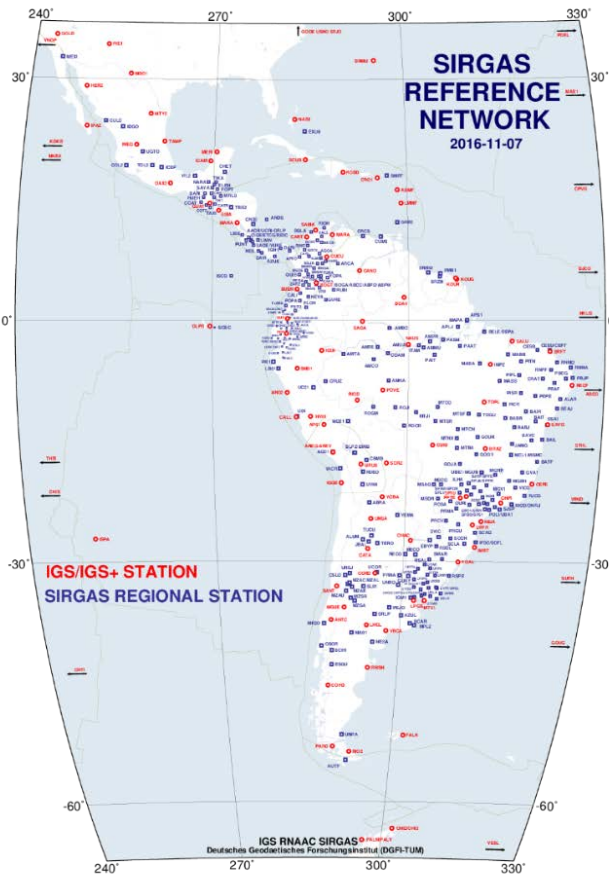
SIRGAS in numbers today (2/2)

≈350 GNSS stations



- Fiducial stations
- New Fiducial stations





Extremely accurate

The highest level of **theory, technology and data analysis** has to be used to achieve positions with mm-accuracy and velocities with 0.1 mm/a. **Stability** over decades has to be guaranteed.

SIRGAS-CON

SIRGAS Working Group on Reference System

**Core Network
SIRGAS-C**

**National
Reference Networks
SIRGAS-N**

**1 Regional Data Centre
(DGFI-TUM)**

**National Data Centres
(entities in charge of
national reference frames)**

**1 Analysis Centre
(DGFI-TUM as
IGS-RNAAC-SIR)**

**9 Local Processing
Centres**
CEPGE, CNPDG-UNA, CPAGS-LUZ, IBGE,
IGAC, IGM-CL, IGN-Ar, INEGI, SGM-Uy

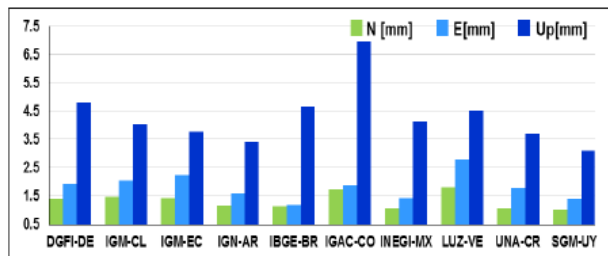
**2 Combination Centres
(DGFI-TUM, IBGE)**

**Final solutions for the
SIRGAS reference frame**

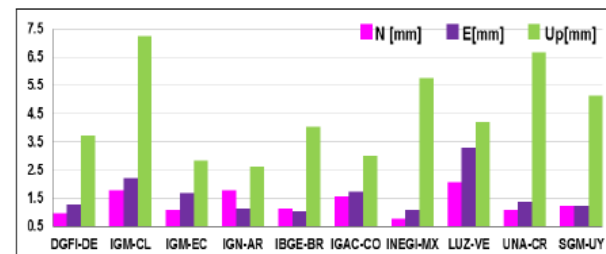
Loosely constrained
weekly solutions for
IGS polyhedron and
multi-year solutions

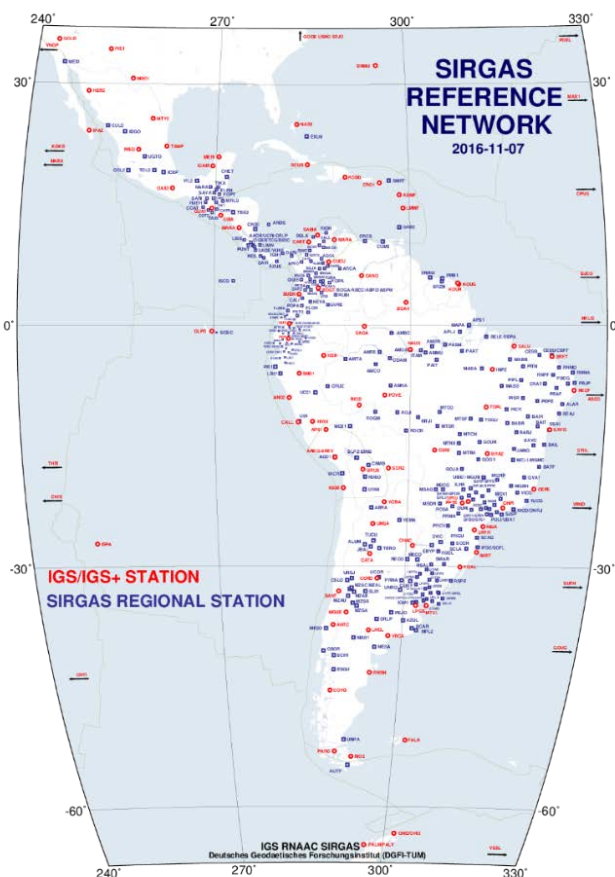
- Weekly station positions
aligned to the ITRF
- Multi-year solutions
(positions + velocities)

Consistency of the weekly coordinate in the individual solutions



**Reliability of the individual solutions
(comparison with IGS)**



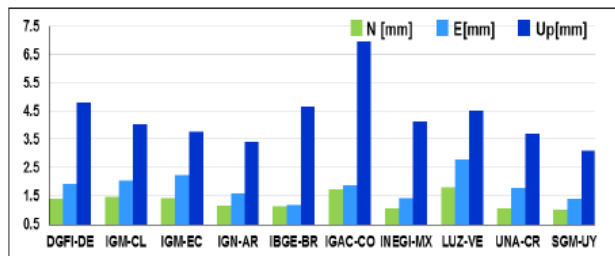


Extremely accurate

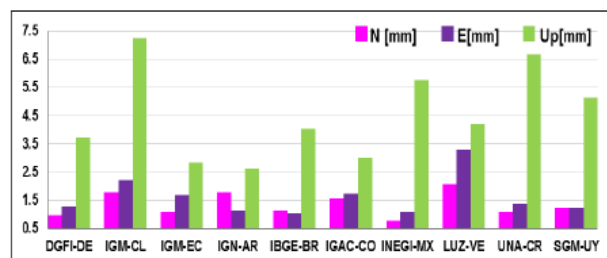
The highest level of **theory**, technology and **data analysis** has to be used to achieve positions with mm-accuracy and velocities with 0.1 mm/a. **Stability** over decades has to be guaranteed.

SIRGAS-CON

Consistency of the weekly coordinate in the individual solutions



Reliability of the individual solutions (comparison with IGS)



SIR15P01 – VEMOS2015 Model

Period: 2010.2 (2012.2) - 2015.2;

471 stations;

Frame: IGB08 epoch 2013.0;

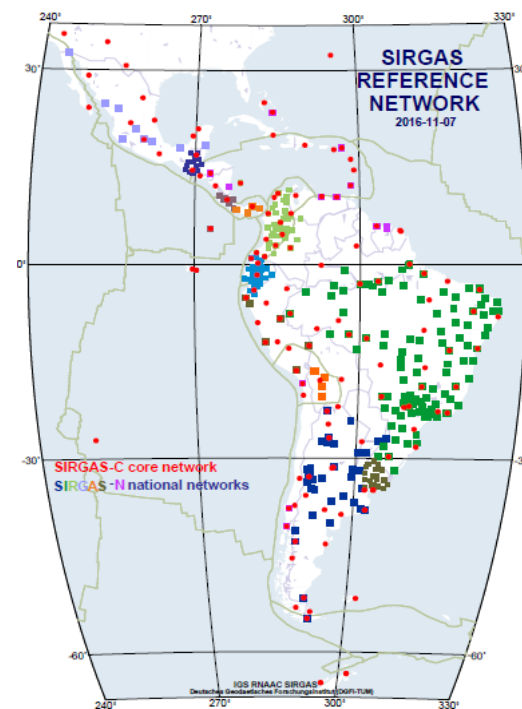
Precision: N - E = ± 1.0 mm/y,
h = ± 1.2 mm/y

Country	Nacional Network / CON	Number of stations
Argentina	POSGAR/ RAMSAC	178/ 45
Bolivia	MARGEN / CON	125/ 7
Brasil	SIRGAS2000 /RBMC	1903/128
Chile	SIRGAS-CHILE /CON	269/9
Colombia	MAGNA-SIRGAS /MAGNA-ECO	70/47
Costa Rica	CR05 / CON	15
Ecuador	Red básica GPS /REGME	135/ 37
El Salvador	SIRGAS-ES2007 / CON	34/1
Guyana Francesa	RGFG /CON	7 / 1
Guatemala	CORS	15
México	RGNO /REGNA	17
Panamá	MGN /CON	17/7
Perú	PERU96 / REGPMOC	47 / 14
Uruguay	SIRGAS-ROU98 / REGNA-ROU	17 / 23
Venezuela	SIRGAS-REGVEN / REMOS	156 / 3

National datums

Extremely reliable

National datums are basic for **legal** affairs (borders), **geo-information**, and constructions. Required precision is not as high, but it has easily to be handled & results have to be reliable.



Central America :
5 countries

South America: 10
countries



SIRGAS-RT

The RT Station number and RT casters number are increasing

. Unified heights

Highly consistent

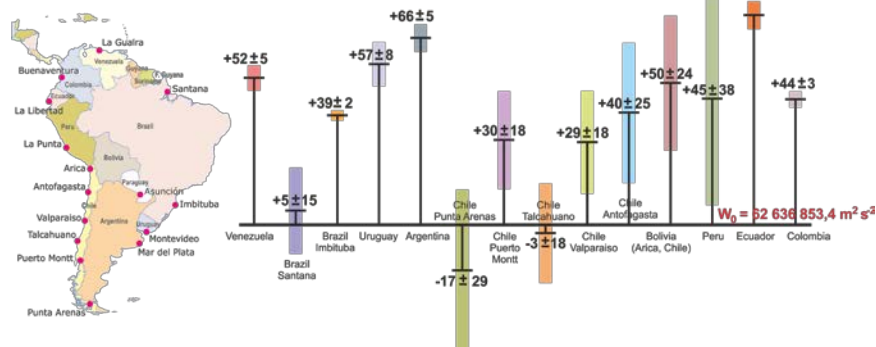
Heights for use in practice are in general physically defined, referring to the gravity field. Therefore position & gravity related parameters must be completely consistent.

SIRGAS
WG-III
Levelling

SIRGAS
WG-III
GNSS

SIRGAS
WG-III
Gravity

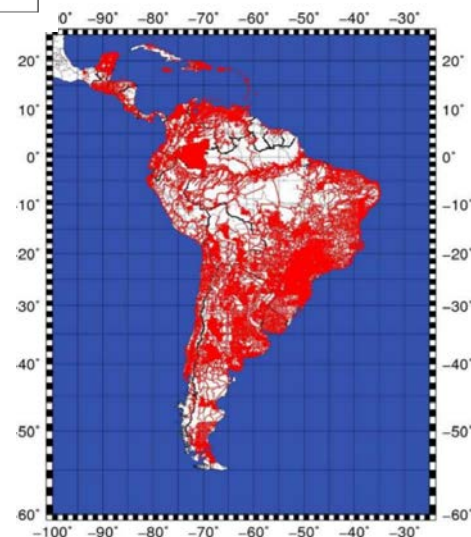
15 Vertical Datums in South America.
(L.Sanchez)



Large gaps in
leveling lines and gravity

Gravity Densification
Network in South/Central
America
951.928 points

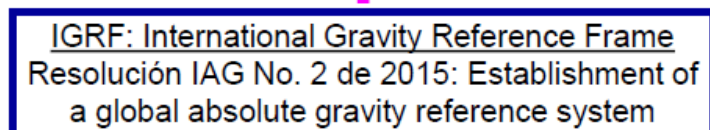
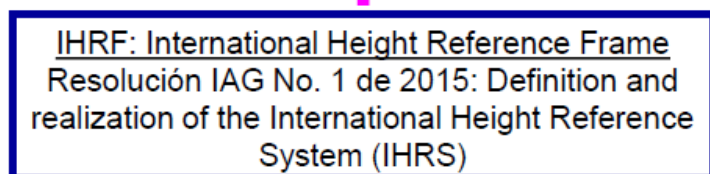
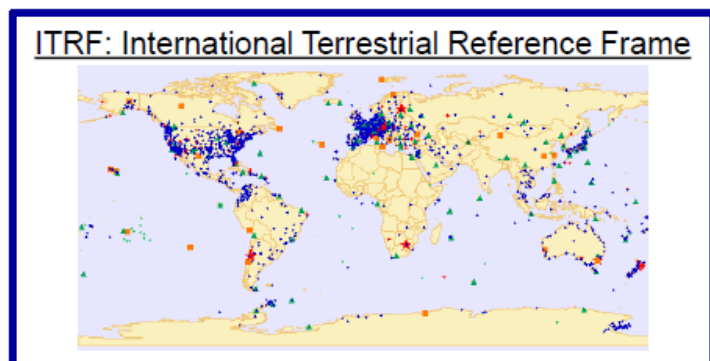
(Blitzkow et al. 2016)



- 1) **The 2015 United Nations General Assembly** adopted the Resolution A/RES/69/266 to promote the Establishment of a Global Geodetic Reference Framework (GGRF) for sustainable development.
- 2) **The International Association of Geodesy (IAG)**, as the responsible organization for the advance of Geodesy at the World, drew up a paper describing the scientific bases for the GGRF implementation in order to achieve the UN objectives.
- 3) **The UN** (through the Resolution and the new **permanent and regional committees for the GGRF**) provides the necessary governmental framework for the promotion and **establishment of GGRF**.
- 4) **The IAG** provides the scientific and theoretical foundations, infrastructure observational and analytical methods, and a broad human network composed by hundreds of experts working together in favor of the GGRF.

The establishment of the GGRF (Global Geodetic Reference Framework) is one of the main goals of GGOS (Global Geodetic Monitoring System) and IAG (International Association of Geodesy).

Terrestrial Componente



The concept of the IAG on GGRF

Common reference frame for identifying and describe the geometry and Gravity field of the Earth at any time.

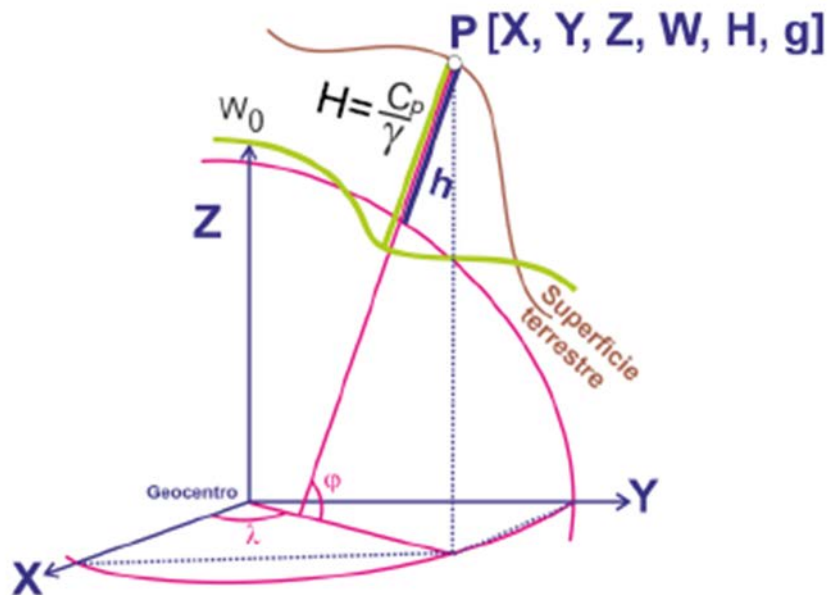
The accurate realization of the GGRF (GGRF) is indispensable to generate reliable geospatial information required in:

- * The determination of the changes that take place within the Earth System.
- * The generation of policies for sustainable development

SIRGAS has been working, in this, since 24 years in the American region.

The establishment of the IHRF (International Height Reference Frame) is one of the main goals of GGOS (Global Geodetic Observing System) and the IAG.

Terrestrial Component



The concept of IAG on GGRF:

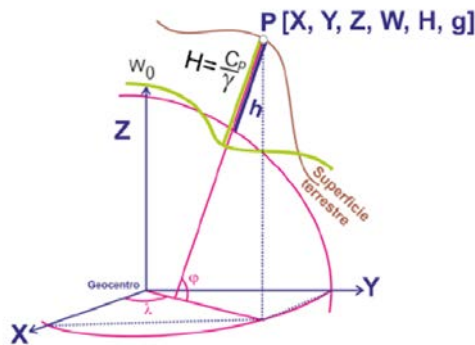
A common reference frame to identify and describe the geometry and gravity field of the Earth at any time.

The coordinates of any point must be given by the geocentric position X, Y, Z , the gravity potential W , its physical height H , and the gravity value g .

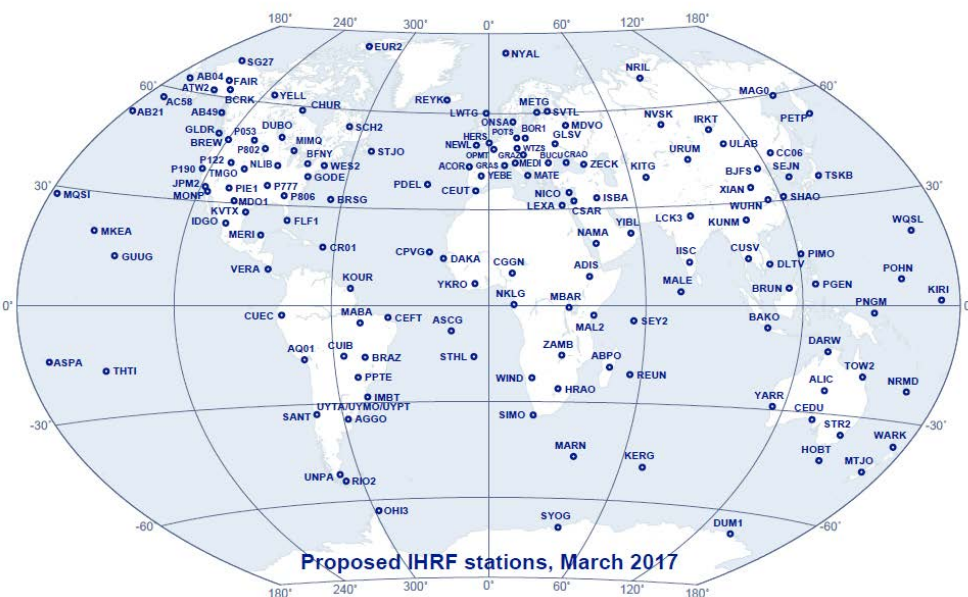
SIRGAS has been working on these topics since 1993 in the American region.

The establishment of the IHRF is one of the main goals of GGOS and the IAG.

The main current SIRGAS precepts related to SVRS :



- Referred to the IHRG global reference level W0;
- Performed by physical altitudes [$HP = f(CP)$];
- Connected to the geometric component of SIRGAS;
- Associated with an specific reference epoch; It should consider the temporal variations.
- Linked to a GGRF station profile.



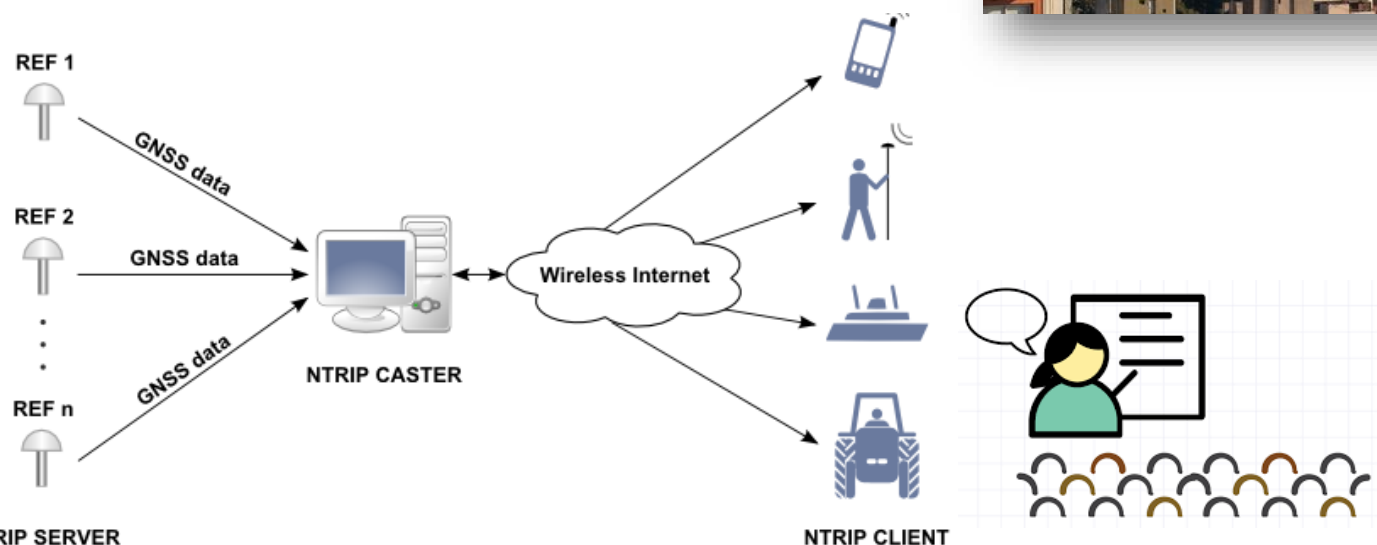
Implementation of the IHRF in SIRGAS

SIRGAS has selected stations that will be part of the IHRF and the countries have undertaken to carry out complementary measurements of φ , λ , h (GNSS), H (leveling) and g (gravity) in the sites and their surroundings according to the guidelines of GGOS

November 22 - 24: Workshop on Real-Time infrastructure, products and applications.

November 27 - 29: Symposium

November 30: Workshop on Satellite Laser Ranging (SLR) instrumentation in Latin America



November maybe.



Symposium

Workshop on : SLR, VRS or RT



We hope you too....

The collaborative effort continues.

SIRGAS faces new challenges according to social and scientific needs.

More data, more accuracy, a better distribution...

¡¡ Thank you very much!!

To those who generate data and maintain the stations.

To the data, processing and combination centers.

To those that collaborate with the Working Groups.

To PAIGH and IAG.

To UN-GGIM: Americas

¡See you in Mendoza 2017!