SIRGAS: Basis for Geosciences, Geodata, and Navigation in Latin America

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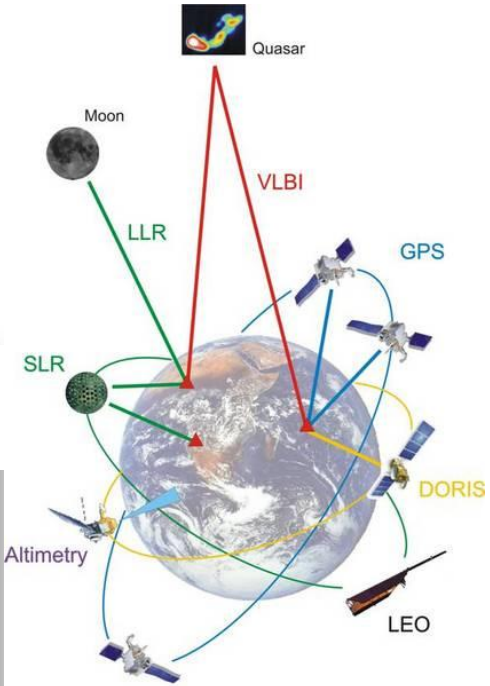
SIRGAS means...

Geodesy:

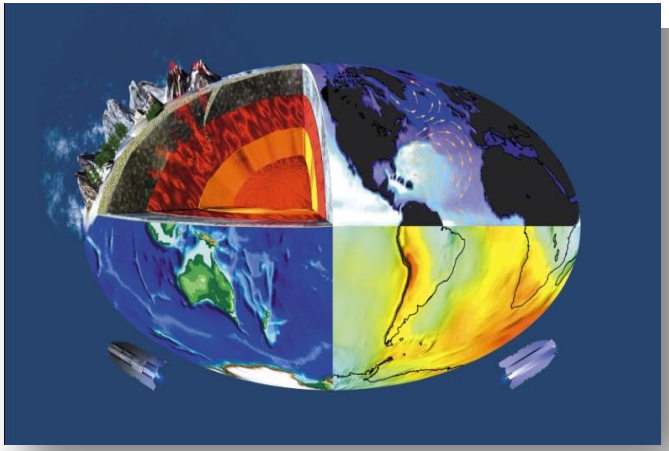
As the science of accurately measure and understand three fundamental properties of Earth: its geometric shape, its orientation in space, and its gravity field; and the changes of these properties with time (Precise Geodetic Infrastructure: National Requirements for a Shared Resource, 2010).



http://geodesy.hartrao.ac.za/

The science for measuring changes in the Earth System.

http://www.igp.ethz.ch/geometh/



http://www.esa.int/esaLP/LPgoce.html

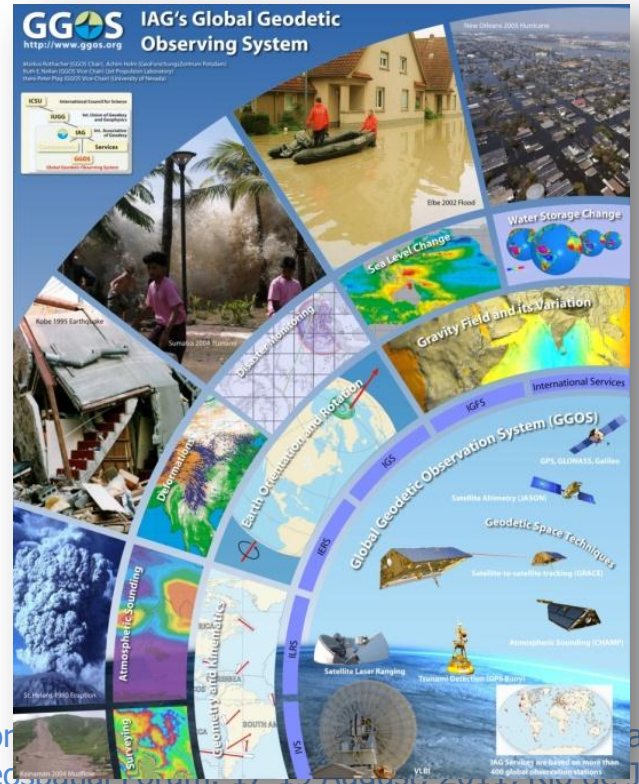
SIRGAS provides the core data for the Americas Geospatial Data Infrastructure.

SIRGAS means...

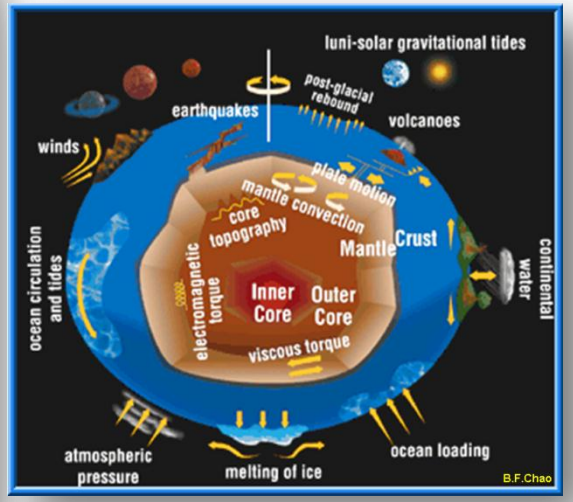
Geodetic infrastructure and observing systems:

As the set of human and technical resources devoted to the long-term definition, maintenance and modernization of a multipurpose continental network, which is a regional densification (realization) of the global International Terrestrial Reference Frame (ITRF). Systems can be set as components of the Infrastructure, oriented to the monitoring and study of different phenomena occurring in Earth System.

- "Global patterns of tectonic deformation
- Global patterns of all types of height changes
- Deformation due to the mass transfer between solid Earth, atmosphere, and hydrosphere including ice;
- Quantification of angular momentum exchange and mass transfer" (Drewes, 2005)



http://ggos.gfz-potsdam.de/

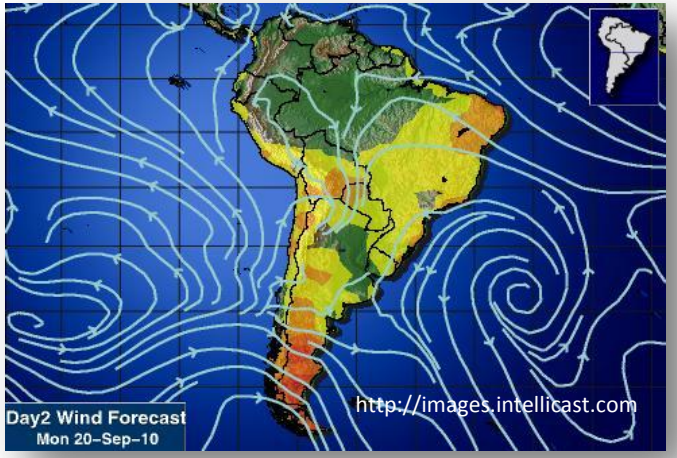


http://www.agu.org/

SIRGAS means...

Earth sciences. As the contribution of geodetic science and techniques to the family of Earth sciences by sharing data, providing services and generating information that combined with those provided by different sources lead to a better comprehension of Earth.

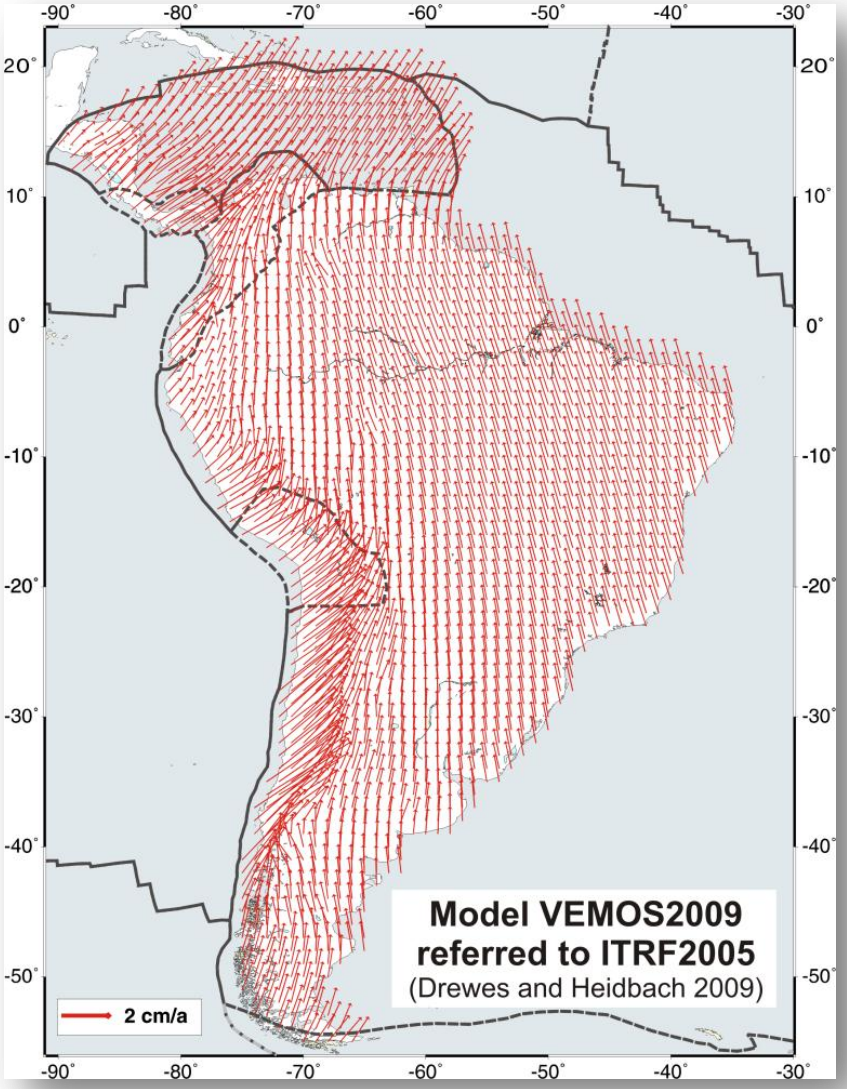
- Geodesy is able to measure several effects of geodynamic and global change processes, including the whole cycle of the water.
- A complete understanding of those processes will require very precise and stable time series of data acquired over many years.
- Measurements and satellite orbits must be tied to a Terrestrial Reference Frame (TRF) that supports millimeter-level accuracy and ensures stability over decades.
- Changes must be continuously monitored with mm/a-level accuracy.



Example: modelling the deformation in South America and the Caribbean

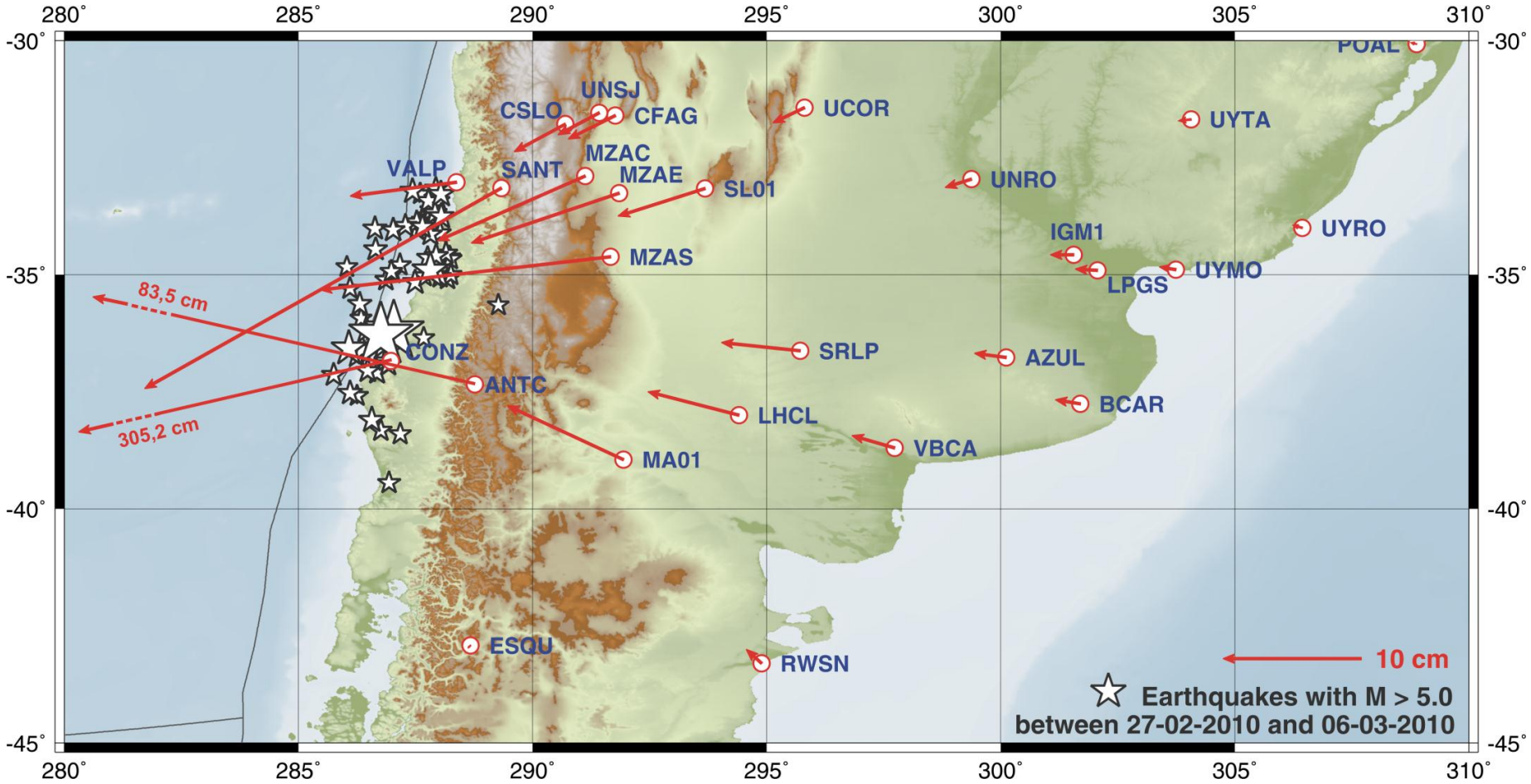
VEMOS: Velocity model for SIRGAS

- To understand and represent the station position changes with time.



Example: measuring seismic effects

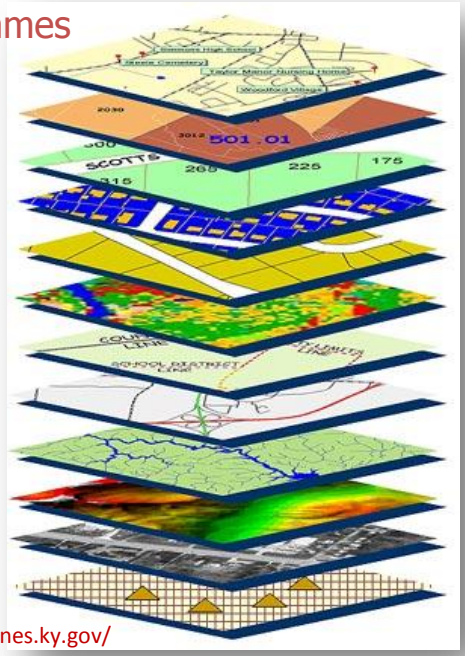
Displacements caused by the earthquake of 2010-02-27 in Chile



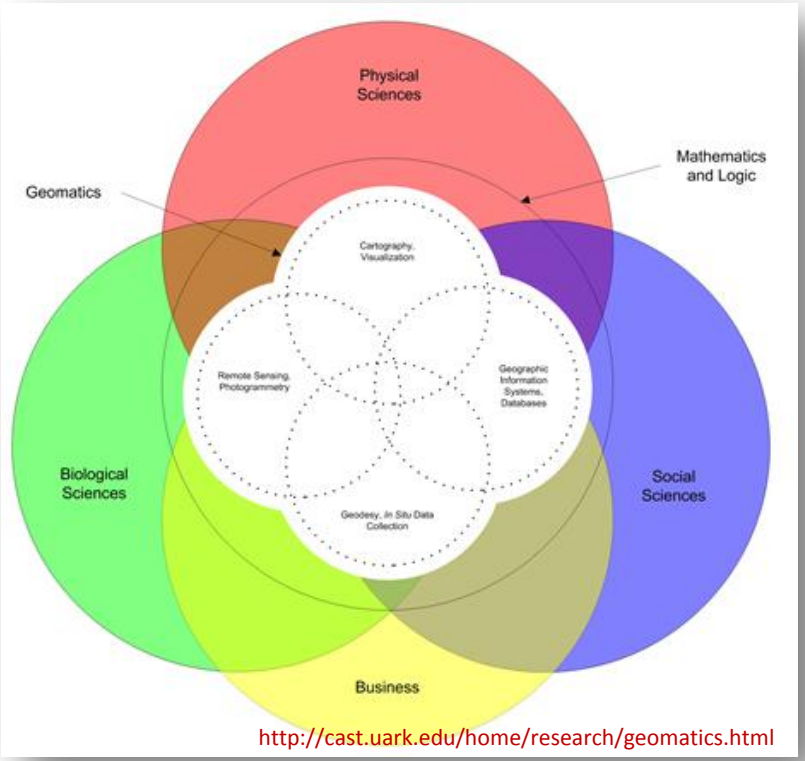
SIRGAS means...

Social benefits. As a practical application focused on solving problems derived from natural hazards, global change and the social evolution itself. It is related to all the elements, variables and processes that can be located by geopositioning. This covers, by far, the most of the human activities and their relation with the environment.

Geographic Names
Census
Addresses
Structures
Parcels
Land Cover
Boundaries
Transportation
Hydrography
Elevation
Orthoimagery
Geodesy



http://www.techlines.ky.gov/



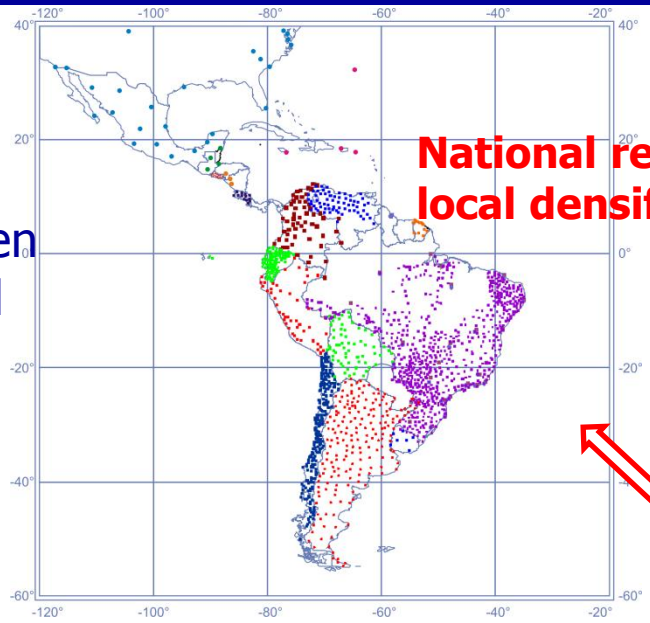
http://cast.uark.edu/home/research/geomatics.html

SIRGAS realization

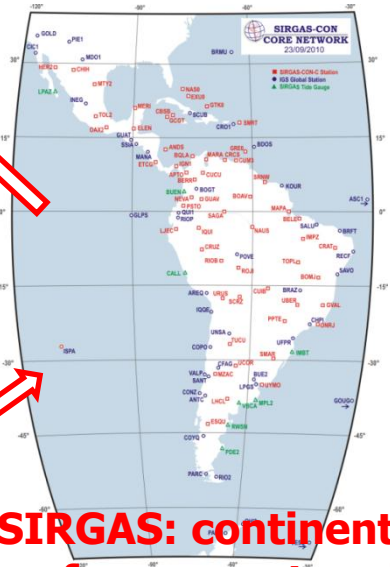
SIRGAS is a densification of the global network ITRF

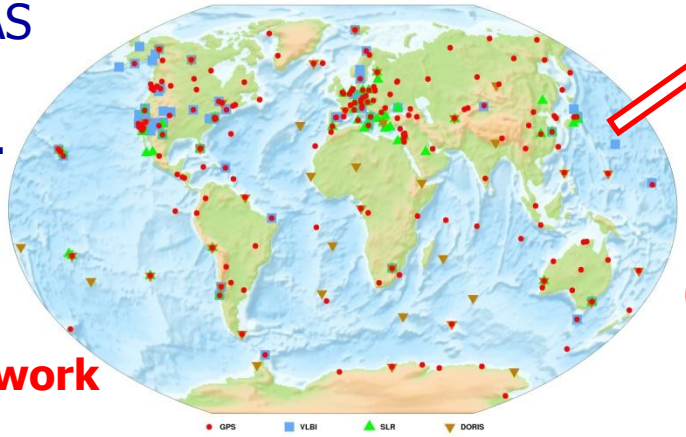
- to guarantee consistency between terrestrial reference stations and GNSS satellite orbits;
- to make the global reference frame available at national and local levels.

As the global ITRF is extended by SIRGAS in Latin America; SIRGAS is extended in our countries by the national reference networks.



National reference networks: local densifications of SIRGAS



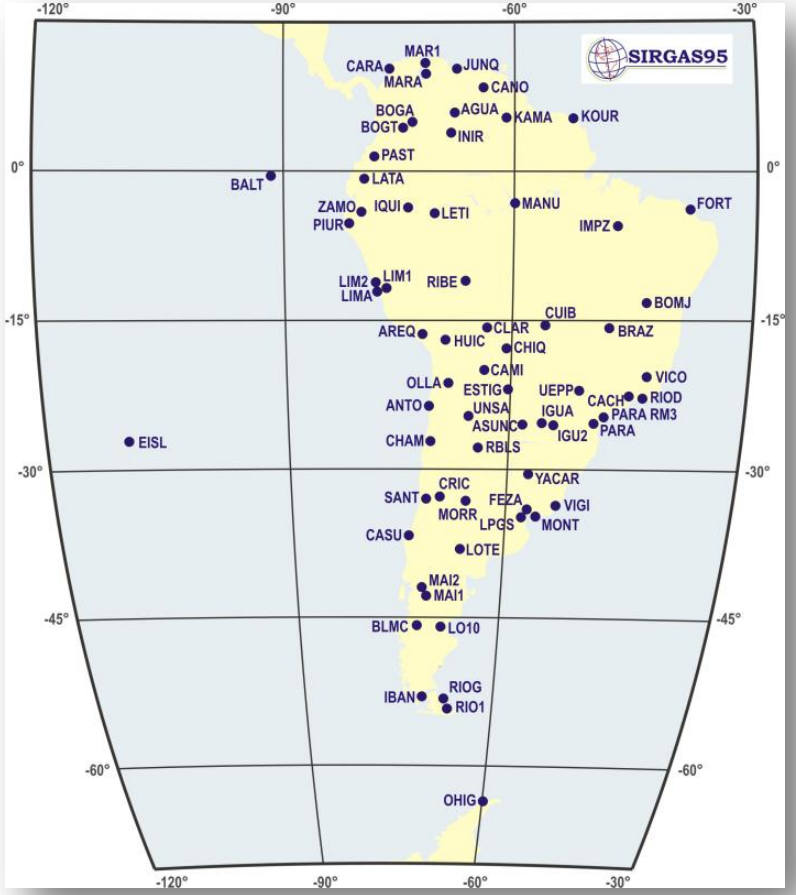


ITRF: global reference network

SIRGAS: continental reference network (regional densification of the ITRF)

Review

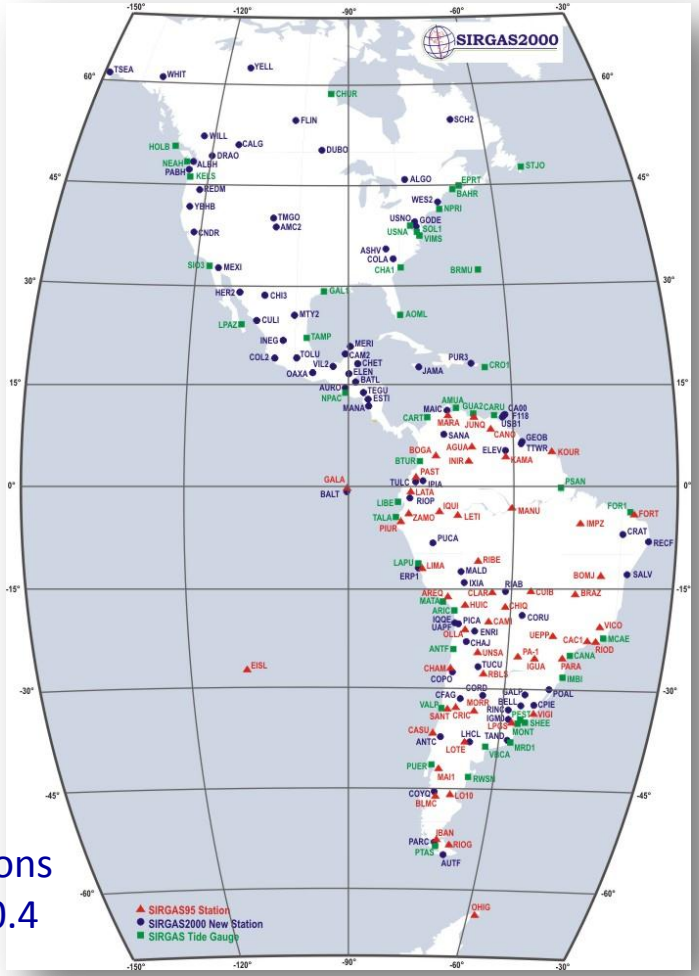
- SIRGAS was established in 1993
- Sponsored by the International Association of Geodesy (IAG), Pan American Institute of Geography and History (PAIGH) and National Geospatial-Intelligence Agency NGA (former DMA, NIMA).
- Standardization of the national reference systems by installing a unified continental network in 1995 and by transforming the old national networks to continental one.



SIRGAS 1995: Refers to ITRF94, epoch 1995.4. High-precision GPS network of 58 points distributed over South America.

Review

- The SIRGAS reference network of 1995 was extended from South America to North- and Central America in 2000.
- The United Nations Organization, through its 7th Cartographic Conference for The Americas (New York, January 22-27, 2001), recommend to adopt SIRGAS as official reference system in all American countries.
- The original acronym of SIRGAS (Geocentric Reference System for South America) was changed in 2001 to Geocentric Reference System for the Americas.



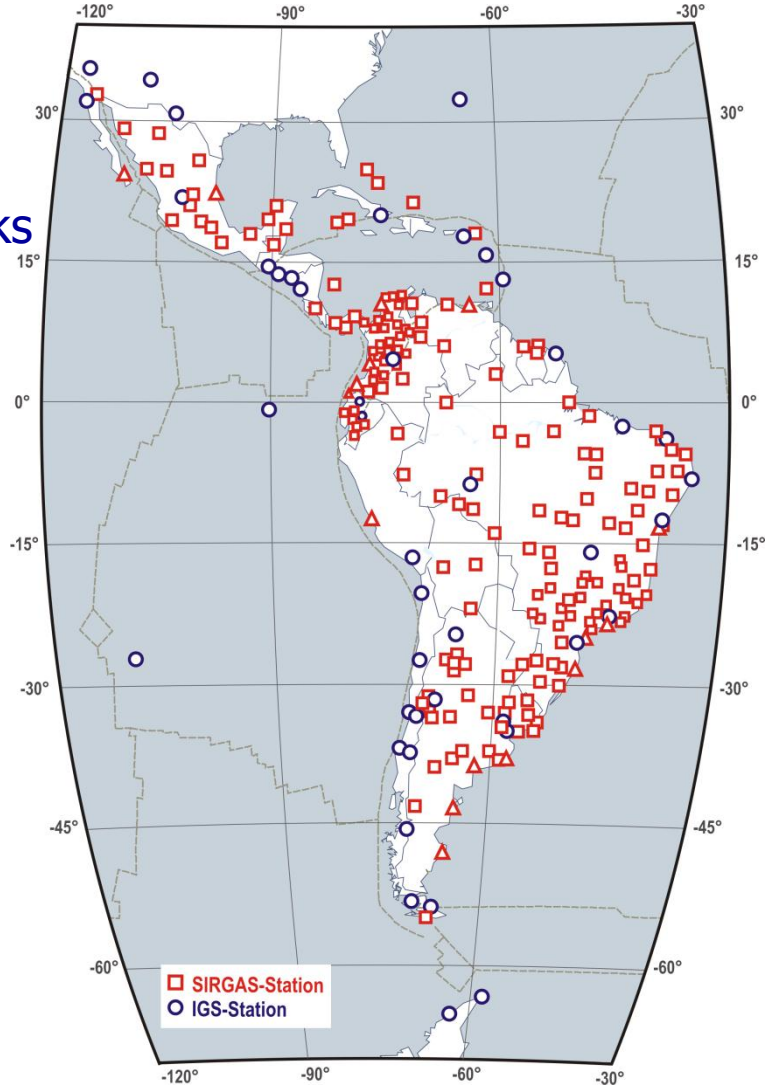
SIRGAS 2000: Includes 184 GPS stations and refers to ITRF 2000, epoch 2000.4

The SIRGAS Continuously Operating Network: SIRGAS-CON

- 242 stations, 48 of them are IGS (i.e. ITRF) sites;
- Distribution of the stations in hierarchic networks (one core network and many densification sub-networks);
- 9 processing centres;
- 2 combination centres;
- each station processed by 3 analysis centres.

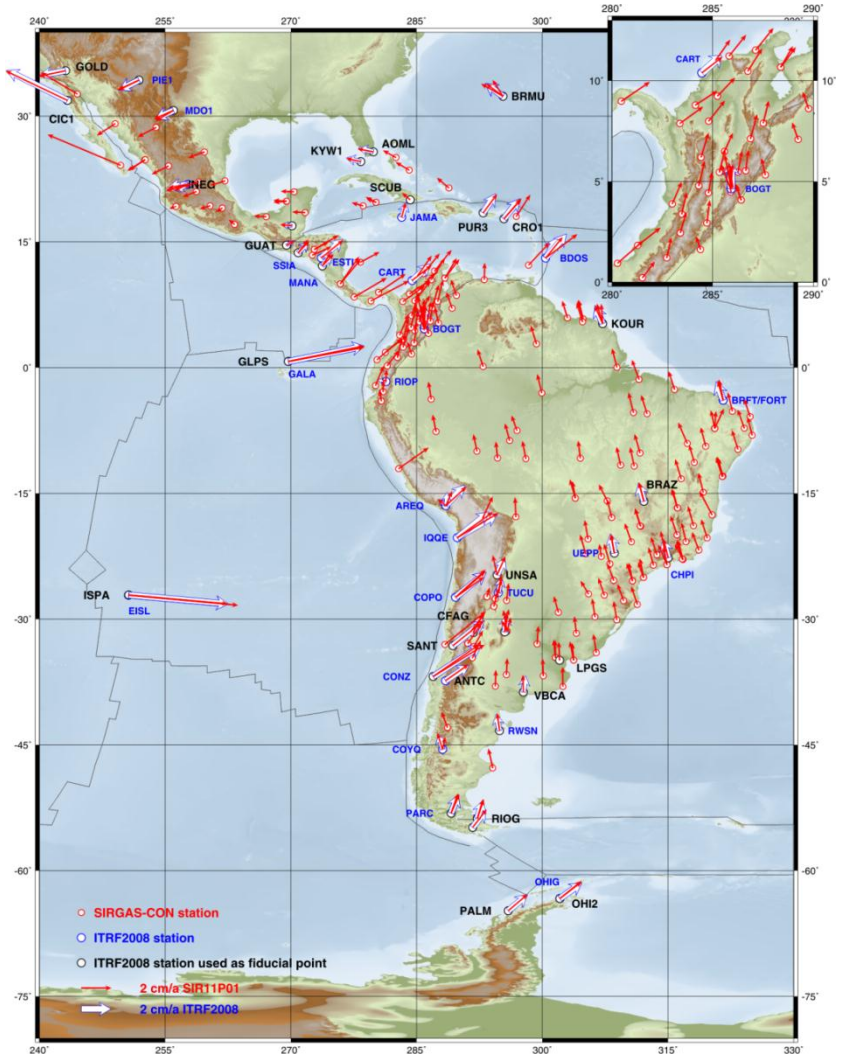
Products:

- Weekly station position with precisions
  N, E = ~±1,5 mm y h = ~±3,8 mm
- Multi-year solutions providing station positions referred to an specified epoch and constant velocities.



Latest multi-year solution SIR11P01

- Time period:
  02-01-2000 – 16-04-2011;
- Stations:
  229 (296 occupations);
- Reference frame:
  ITF2008, epoch 2005.0;
- Station position precision:
  Horizontal: ±1,5 mm
  Vertical: ± 2,4 mm
- Station velocity precision:
  Horizontal: ±0,7 mm/a
  Vertical: ±1,1 mm/a



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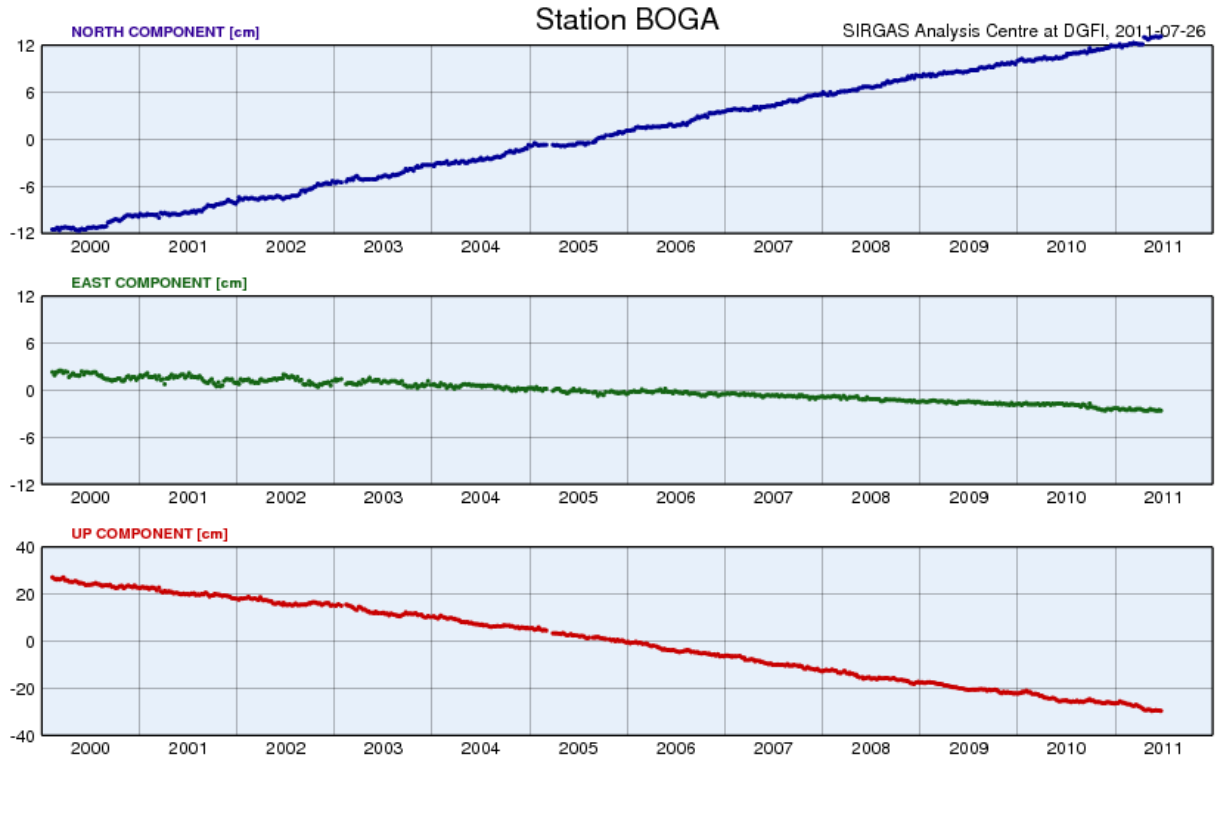
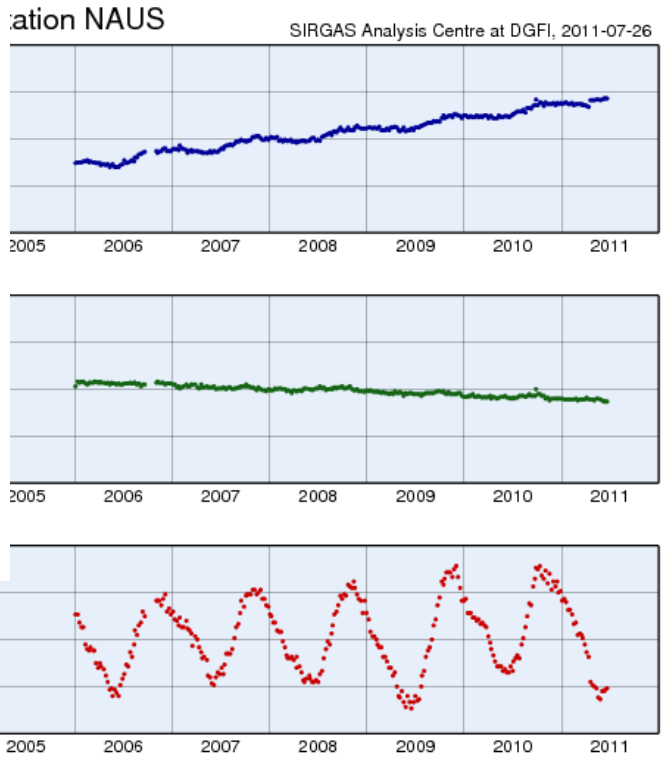




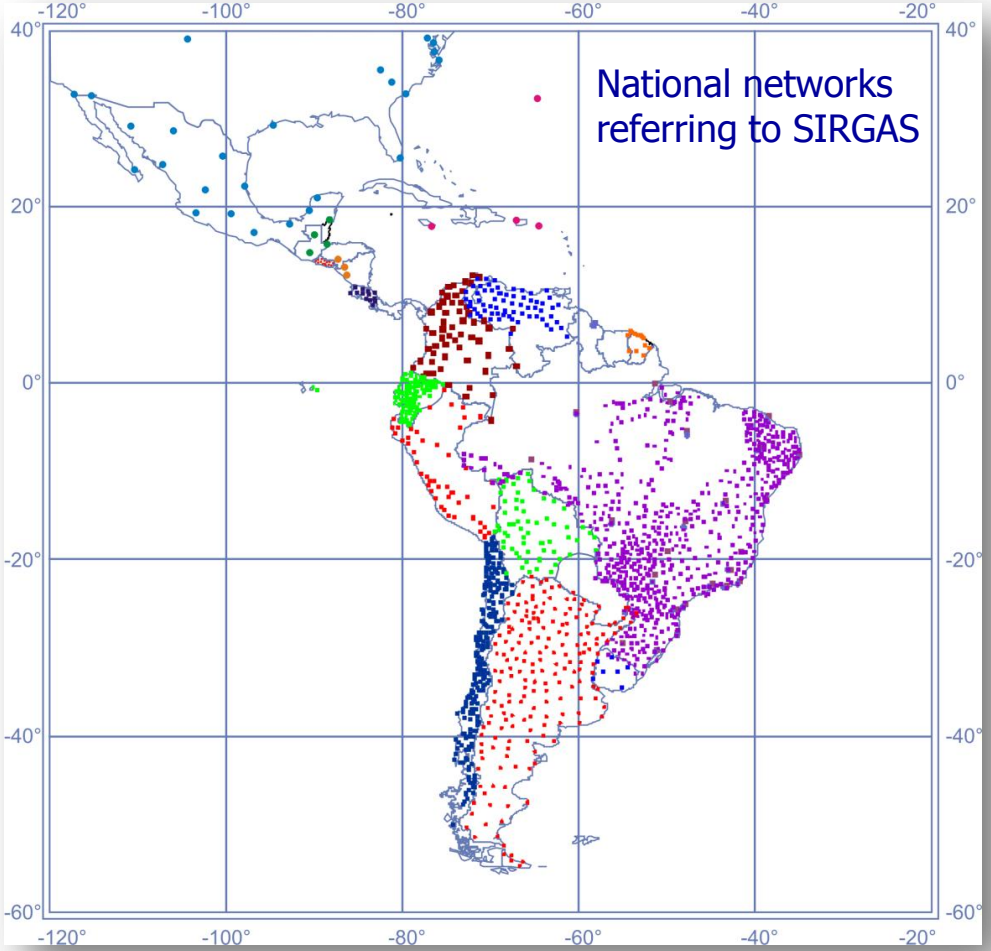
SIRGAS at national level

16 countries with national densification of SIRGAS (by means of a growing number of 250 GNSS continuous stations and more than 2800 passive stations).

Strategy:
i) establishment of a first order GNSS national network (with passive or continuously observing stations),

ii) determination of transformation parameters between the old geodetic datums and SIRGAS, and

iii) adoption of SIRGAS as official frame in each country.



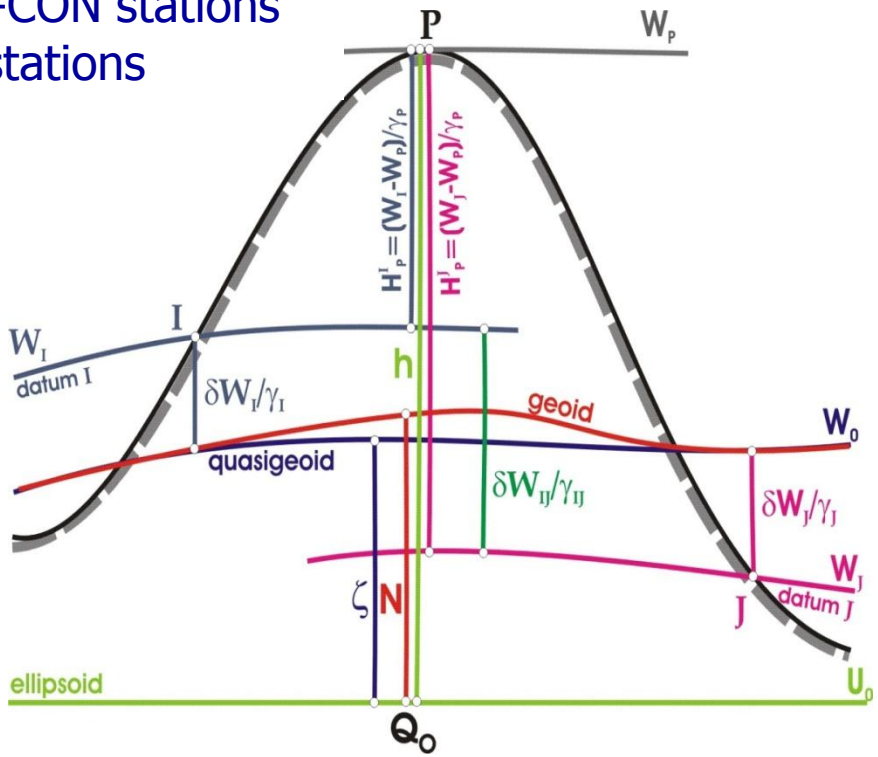
Next challenge: Vertical Datum

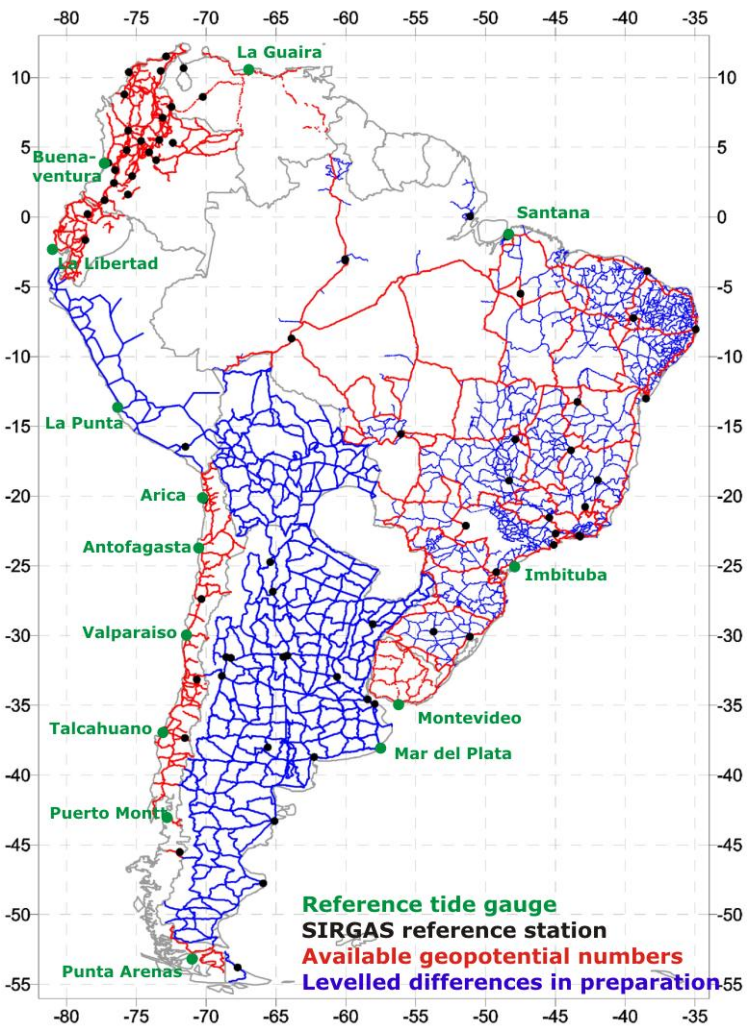
Determination of:

$$\delta W_i = W_0 - W_i$$
$$\delta W_{ij} = W_j - W_i$$

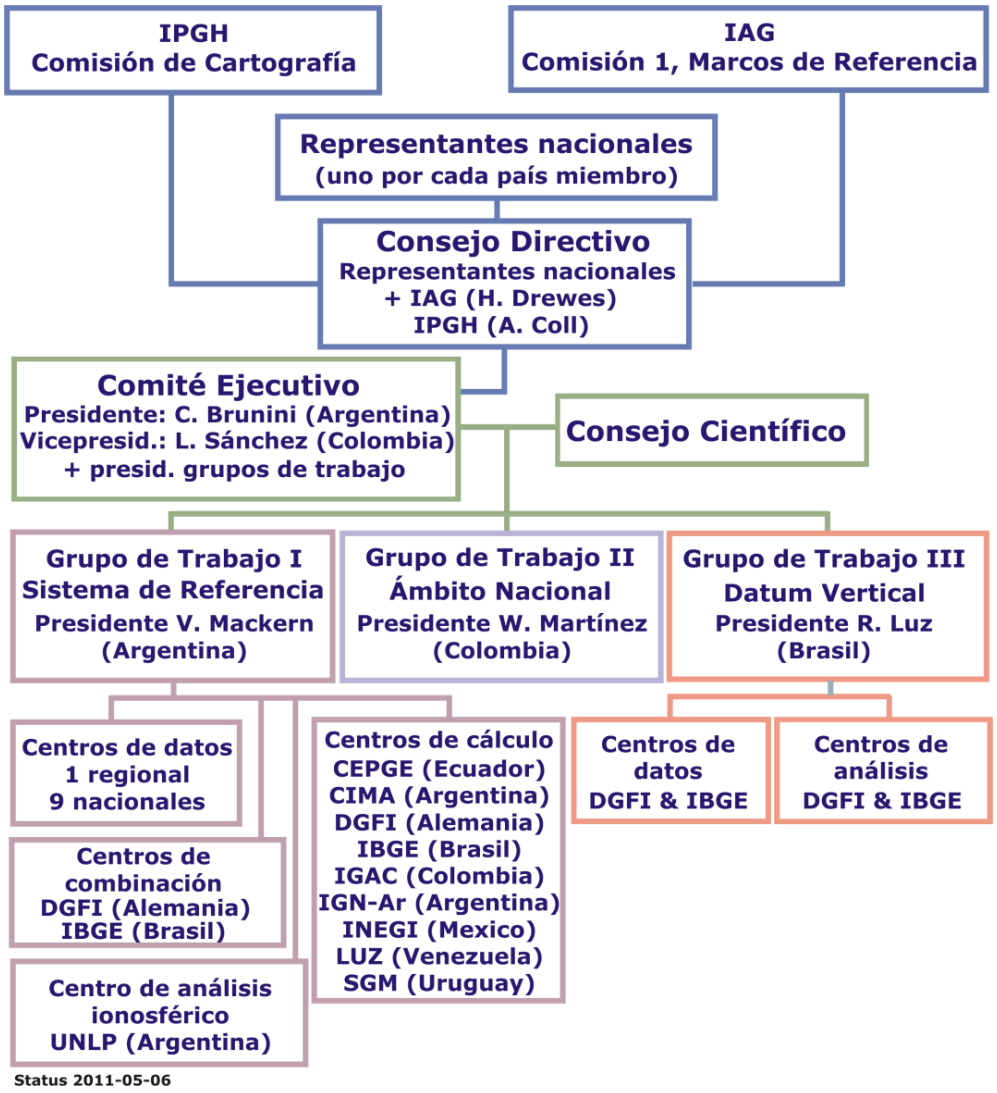
at the:

- reference tide gauges
- neighbor oceanic areas
- SIRGAS-CON stations
- border stations





Organizational issues



SIRGAS is:

- A component of the International Association of Geodesy (to get scientific guidance)
- A Working Group of the Pan American Institute for Geography and History (to get close contact with the Pan American countries and their present necessities in geo-referring spatial data)
- possible thanks to the collaboration and joint work of more than 50 Latin American Institutions!

Final comments

- Navigation and positioning activities based on GNSS are related to the reference frame in which the satellite orbits are computed. This reference frame is the ITRF (International Terrestrial Reference Frame) and SIRGAS is the regional densification of the ITRF in Latin America and the Caribbean.

- Consequently, SIRGAS is the backbone for all projects based on the generation and use of geo-referenced data in a national as well in an international level.

- Besides to provide the reference coordinates for the development of practical applications such as engineering projects, digital administration of geographical data, geospatial data infrastructures, etc., SIRGAS is also the platform for a wide range of scientific applications such as the monitoring of Earth's crust deformations, vertical movements, sea level variations, atmospheric studies, etc.

More information in www.sirgas.org