



Facultad de Ciencias
**Astronómicas
y Geofísicas**
UNIVERSIDAD NACIONAL DE LA PLATA

Opportunities for interaction between GGOS and South America

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Interaction between GGOS and South America? How?



Outline

- ▶ Glimpse of geodetic activities in South America.
- ▶ Present state: interaction between GGOS and South America.
- ▶ Future perspective: interaction between GGOS and South America.

SIRGAS project since 1993

Objectives

- ▶ To establish and maintain a **continental geocentric reference frame** (a network of stations with geocentric coordinates $[X, Y, Z]$ of high precision and their variation over time $[V_x, V_y, V_z]$), in accordance with the recommendations of the International Association for Geodesy.
- ▶ To define, put into effect, and maintain a **unified vertical reference system** by means of physical and geometric heights that are consistent at the global level, in accordance with the recommendations of the IAG.
- ▶ To develop and update a **gravimetric geoid model** for continental coverage, in accordance with the recommendations of the IAG.
- ▶ To establish and maintain a continental **absolute gravity network**, in accordance with the recommendations of the IAG.

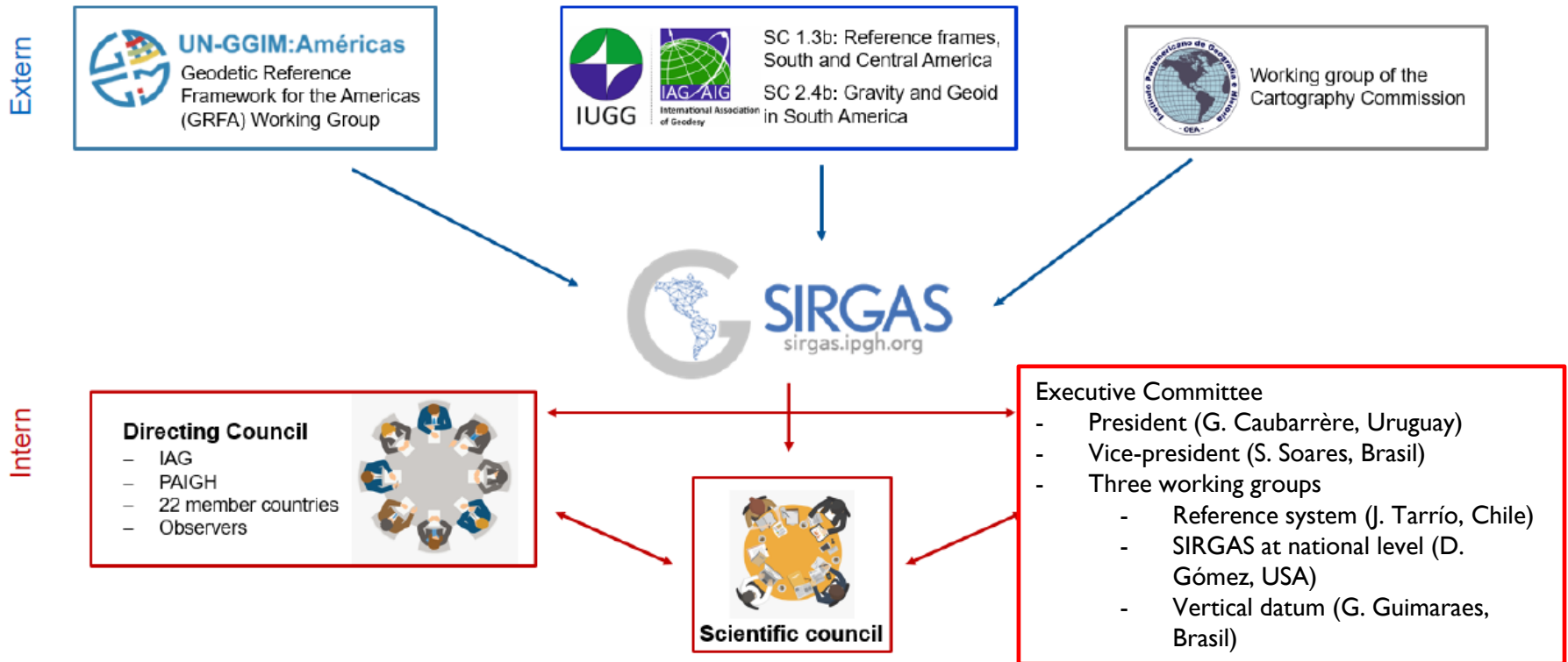
Different names:

- Geocentric Reference System for South America (1993 – 2001)
- Geocentric Reference System for the Americas (2001 – 2020)
- **Geodetic Reference System for the Americas (since 2020)**

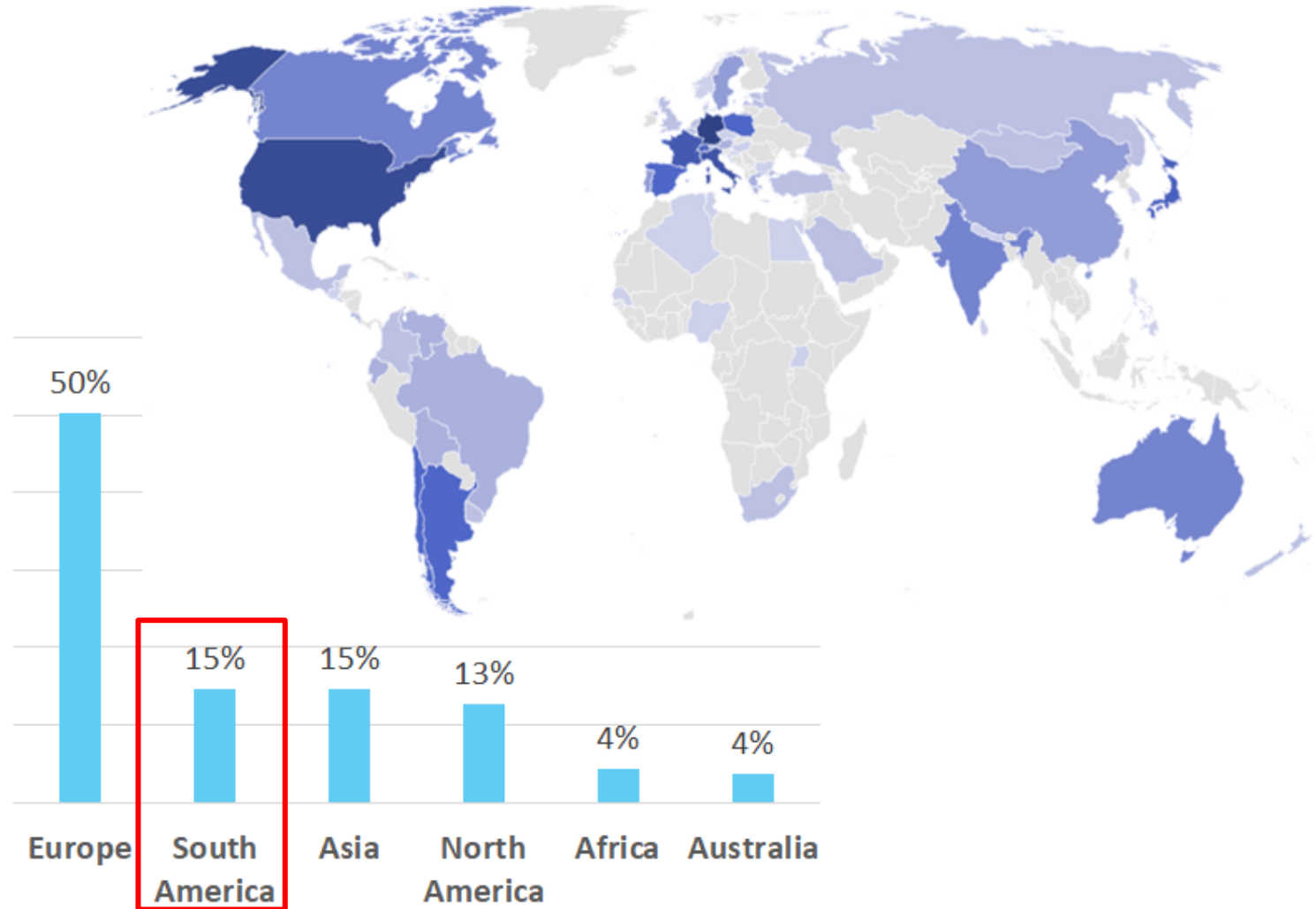
Drewes (2022)



SIRGAS structure



GGOS Survey

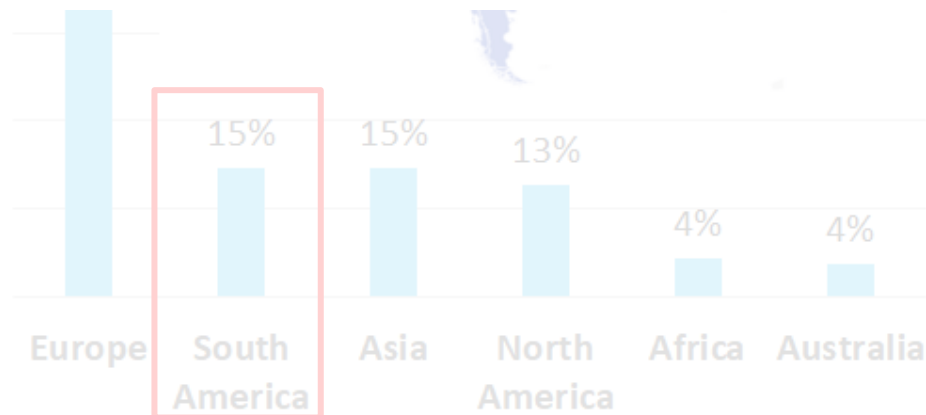


GGOS Survey



Questions:

1. How is the situation regarding **geodetic infrastructure** in South America related to the IAG international services?
2. What are the **geodetic products** available?

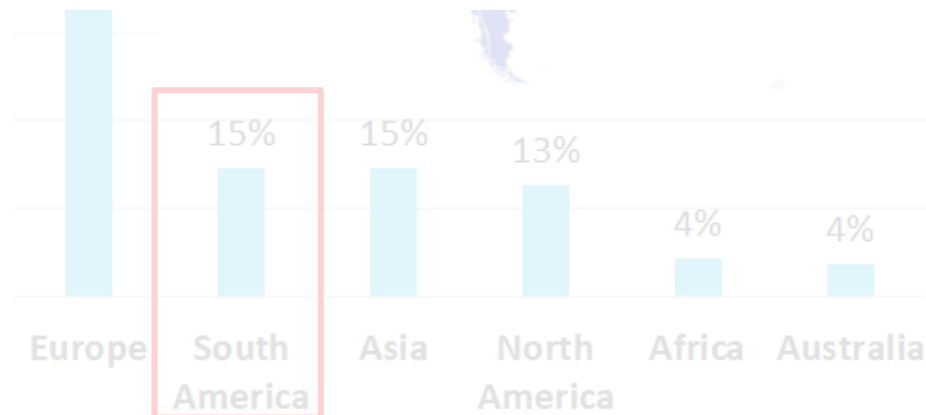


GGOS Survey

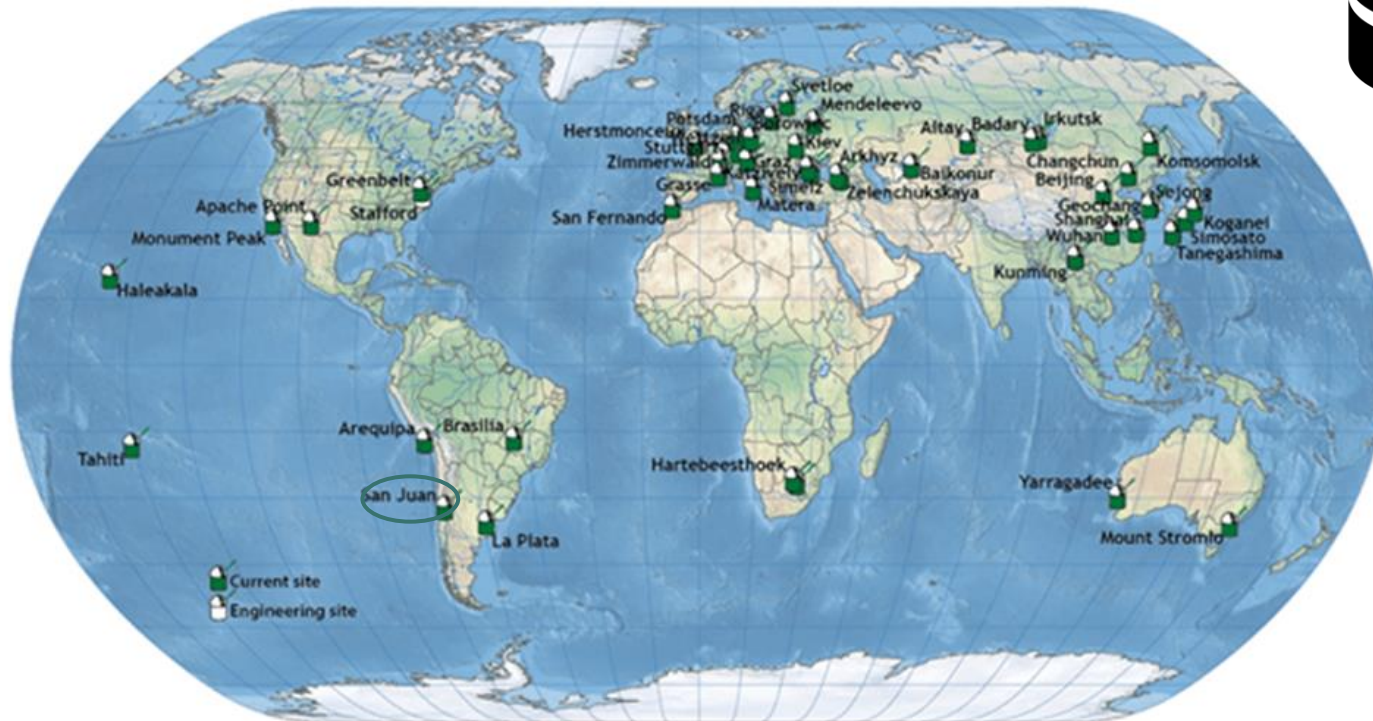


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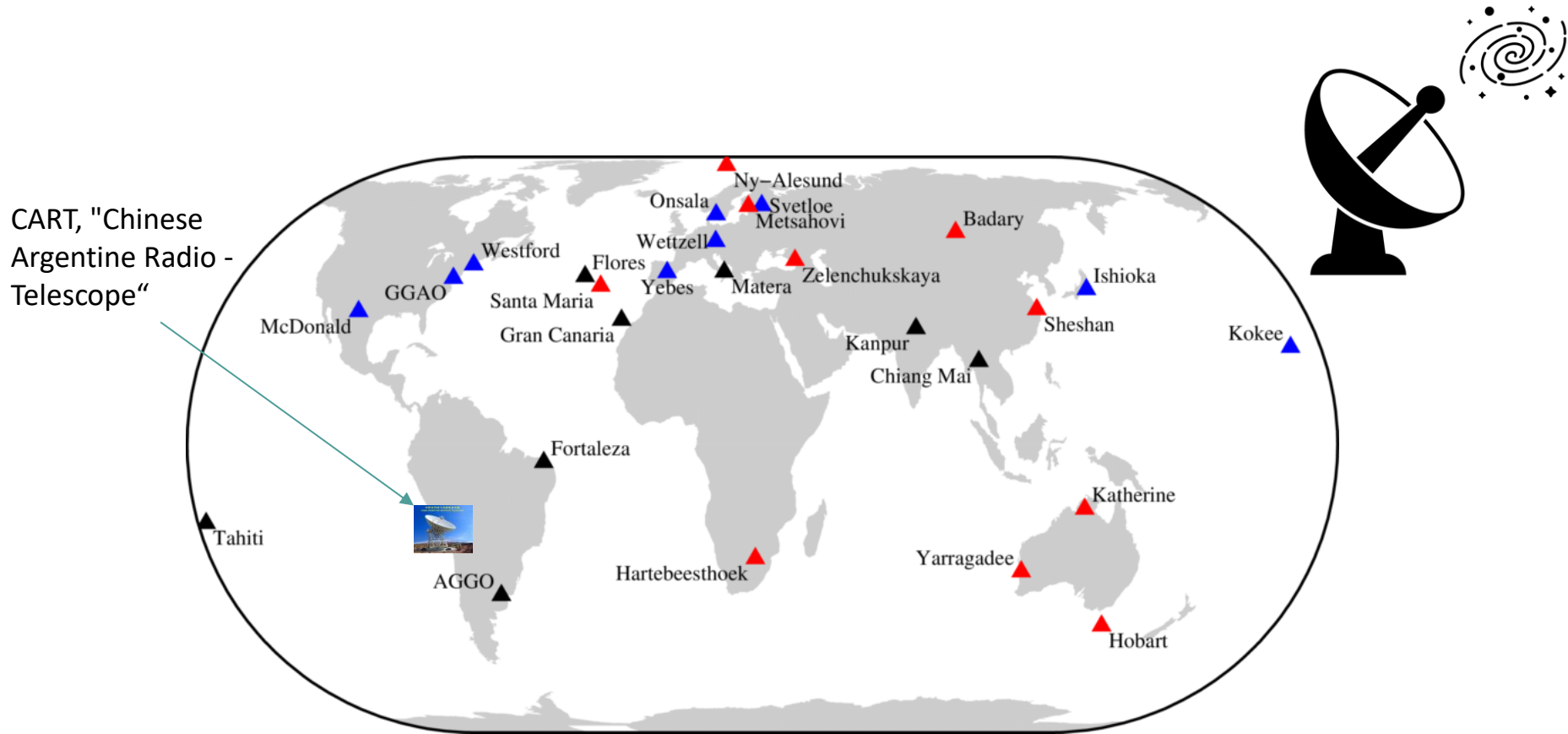


Satellite Laser Ranging stations



<https://ggos.org/item/ilrs/>

VLBI stations

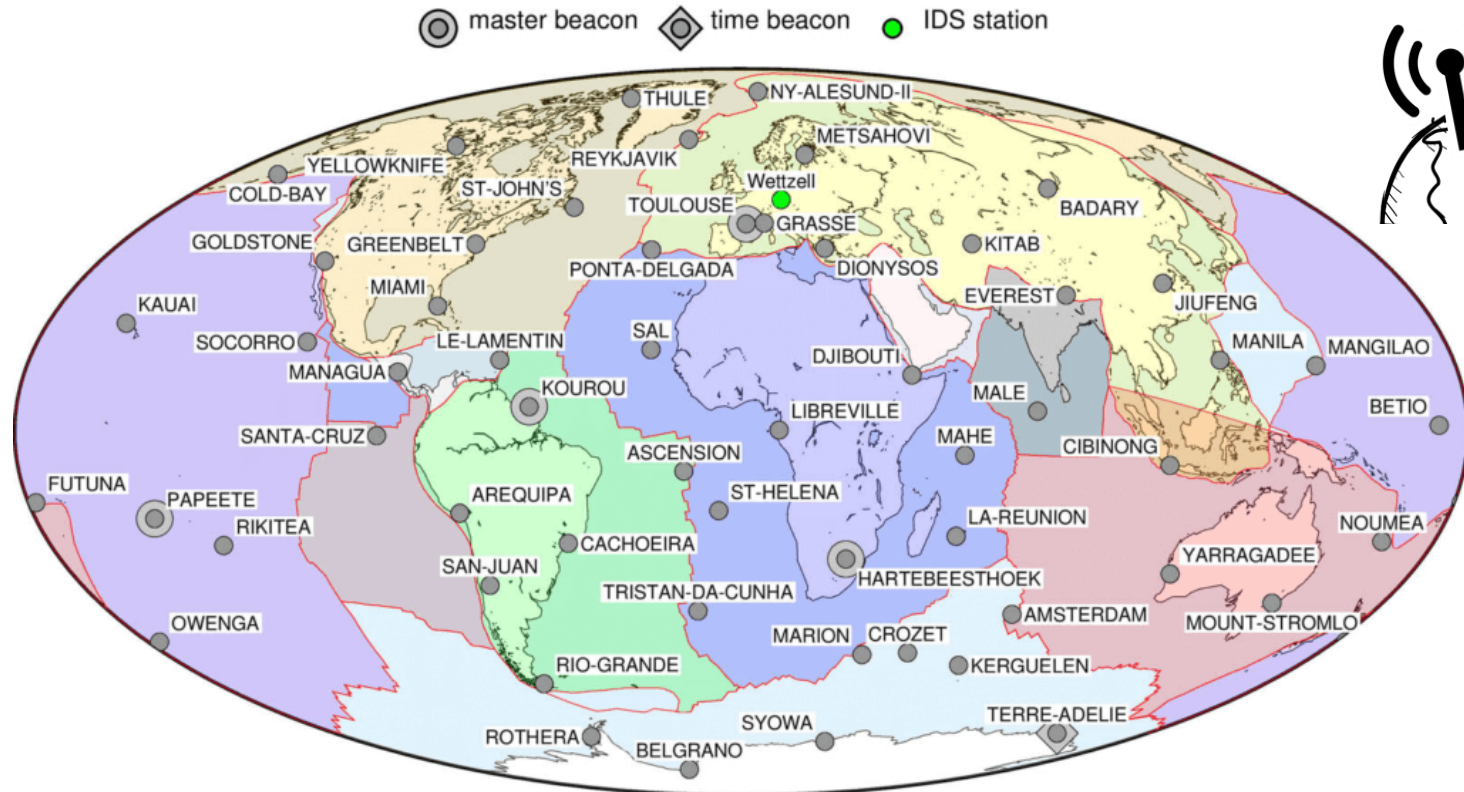


CART, "Chinese Argentine Radio - Telescope"

<https://ggos.org/item/ivs/>

CART, "Chinese Argentine Radio - Telescope" is being installed in San Juan, Argentina.

DORIS stations

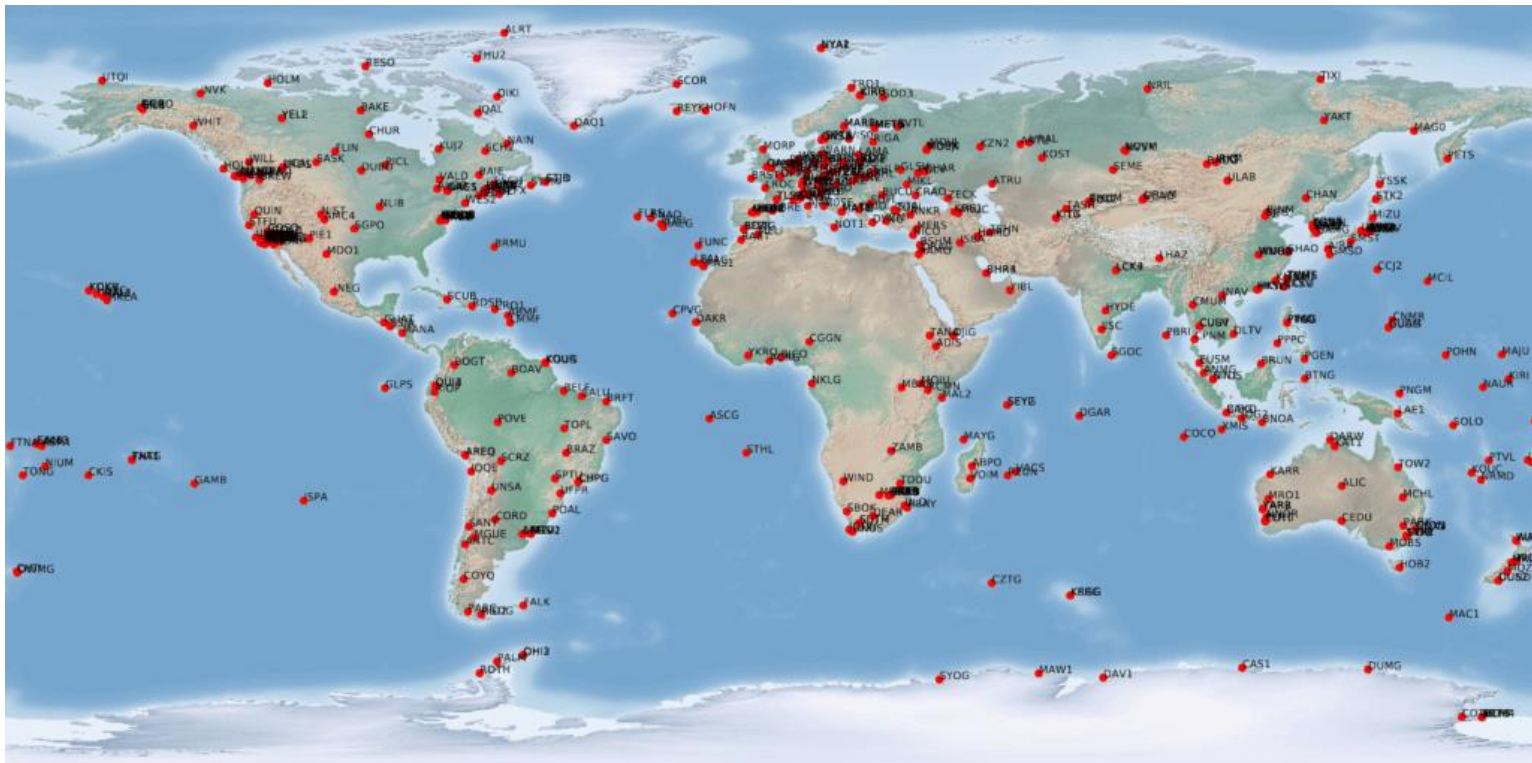


GM 2020 Apr 21 15:55:13 This map was created by IGN-France

<https://ggos.org/item/ids/>

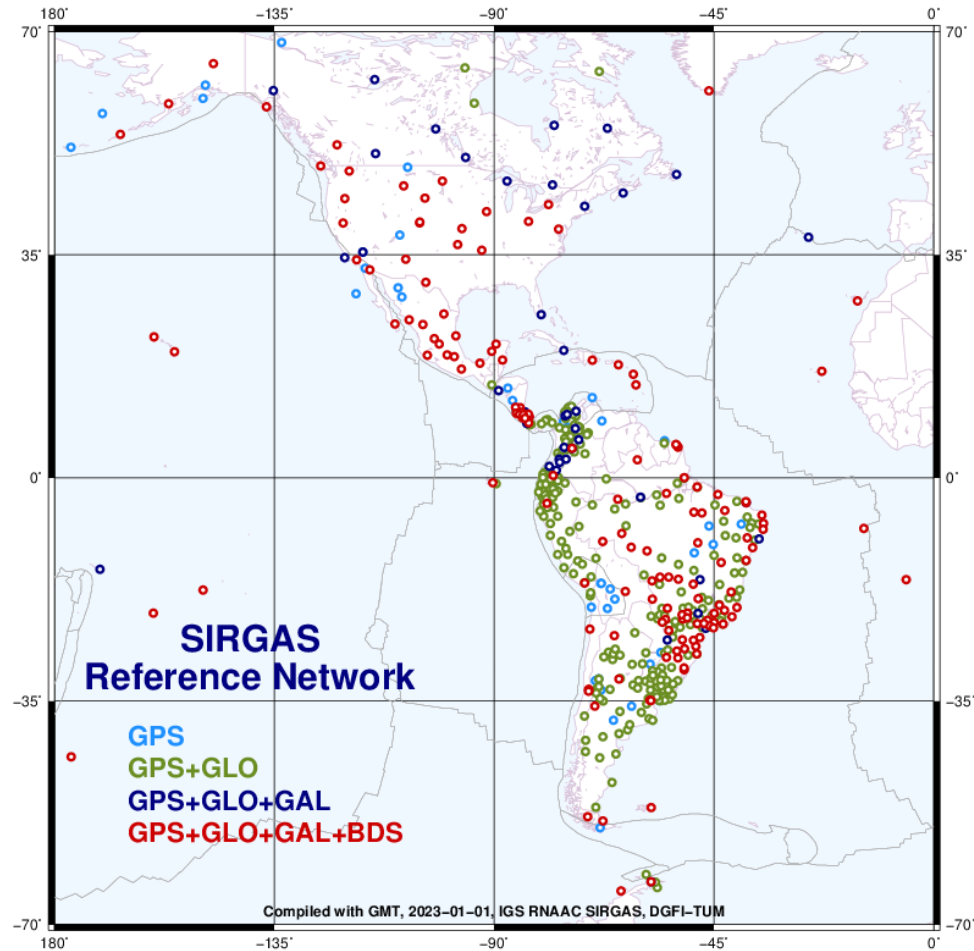


GNSS stations



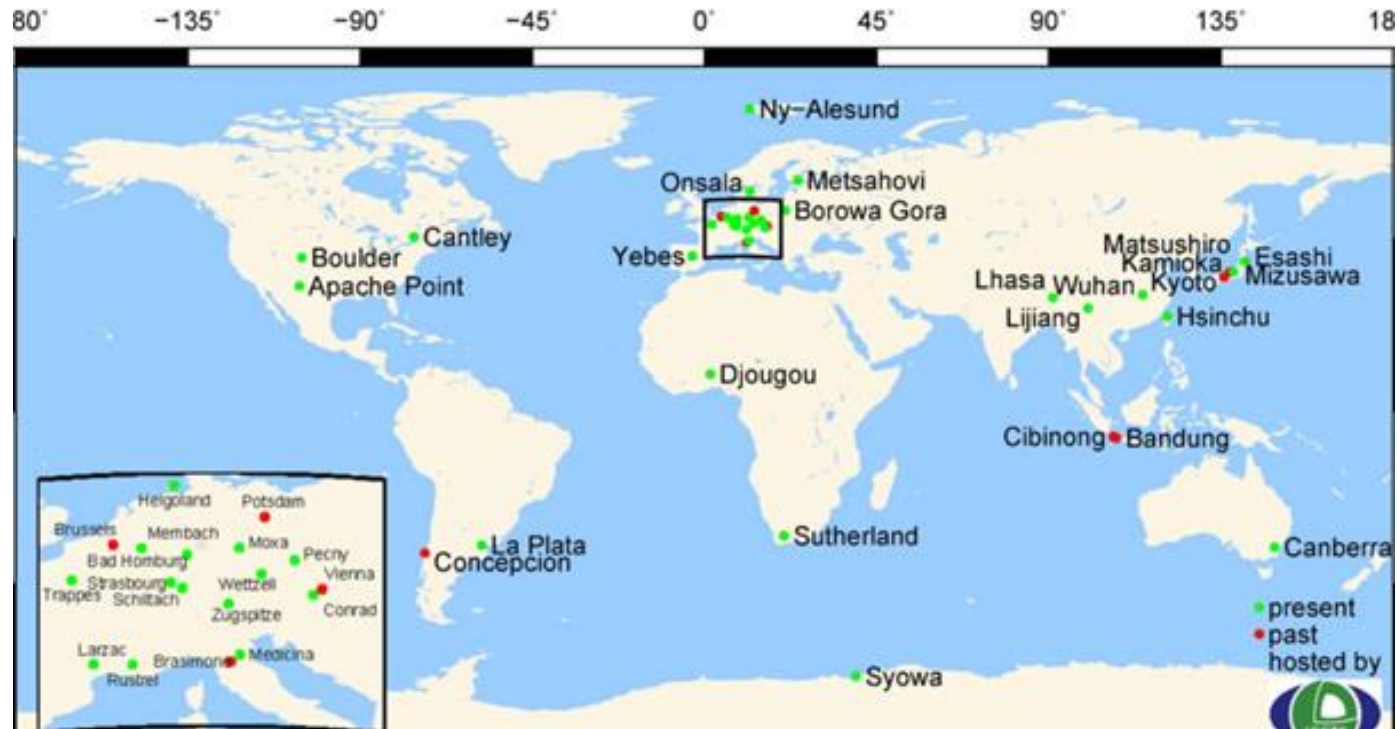
<https://ggos.org/item/igs/>

SIRGAS stations



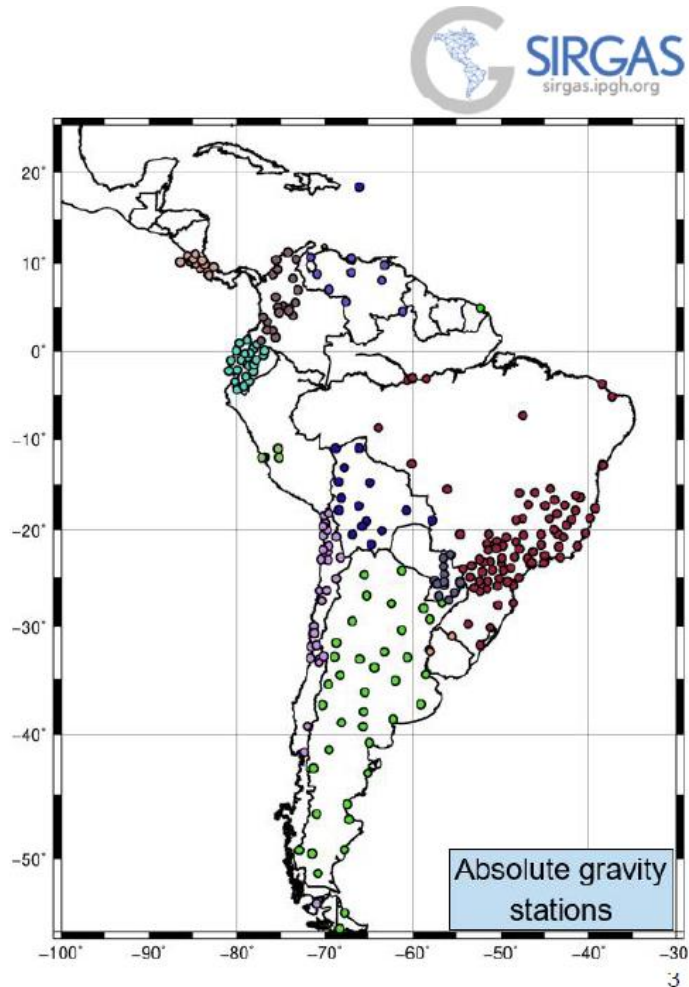
<https://sirgas.ipgh.org/en/gnss-network/stations/maps/>

Superconducting Gravimeter stations



<https://ggos.org/item/igets/>

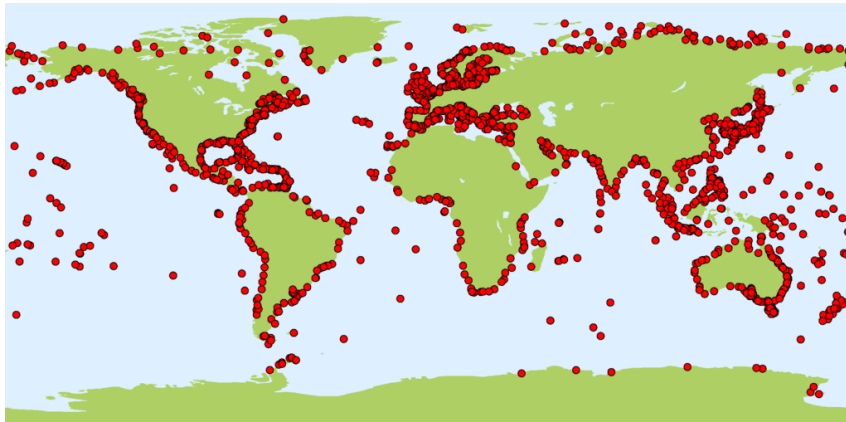
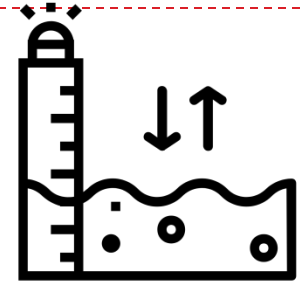
Terrestrial gravimetry: absolute gravity stations



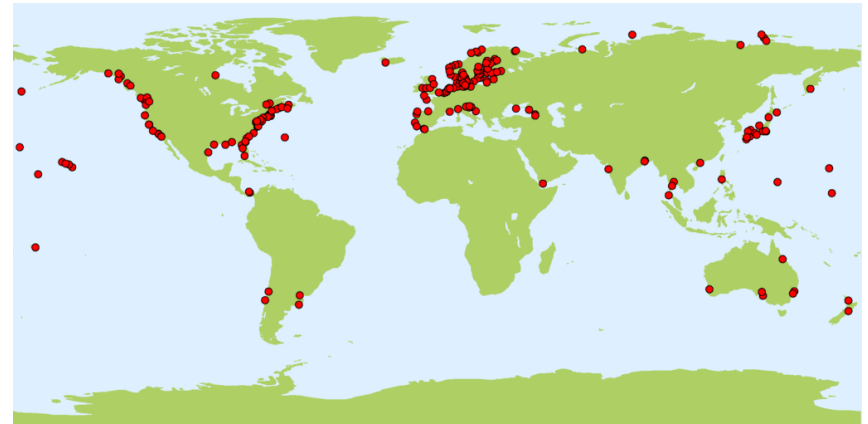
- AI0 was used for measuring different national networks.
- AGGO FG5 was used for calibrating the AGGO SG038, and other geodynamic projects in South America.



Tide gauges stations

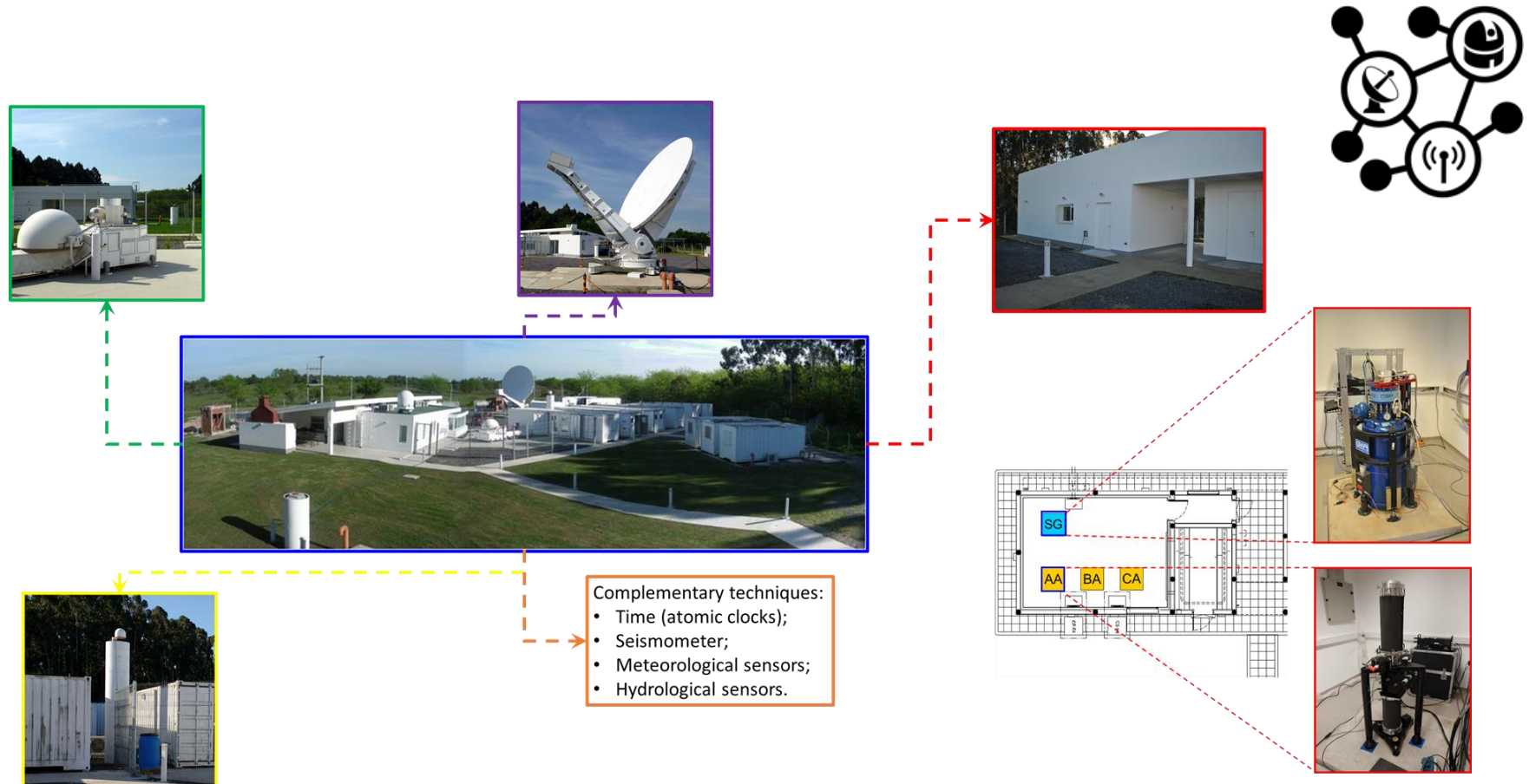


Stations represented in the data set of the Permanent Service for Mean Sea Level (PSMSL)



Stations with long records containing more than 60 years of data

Argentinean-German Geodetic Observatory (AGGO)

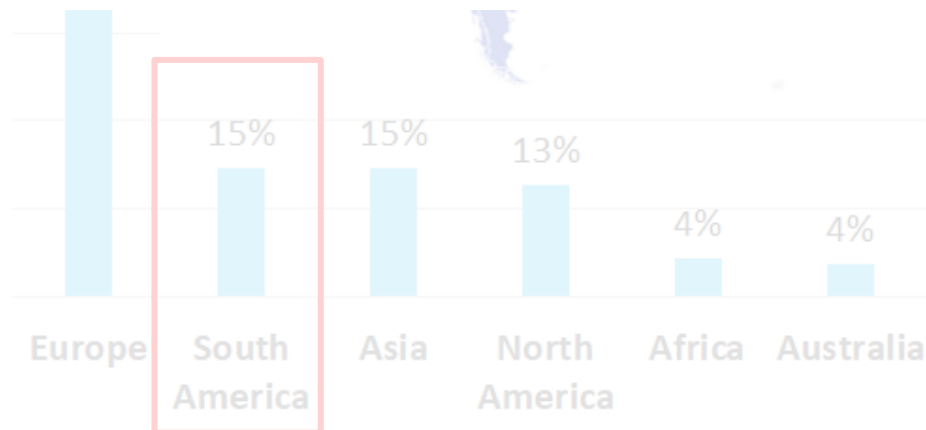


GGOS Survey



Questions:

1. How is the situation regarding **geodetic infrastructure** in South America related to the IAG international services?
2. What are the **geodetic products** available?



Products: Geodetic Themes

- ▶ Contribution to the International Celestial Reference Frame (ICRF)
- ▶ Contribution to the International Terrestrial Reference Frame (ITRF)
- ▶ Contribution to the determination of the Earth Orientation Parameters (EOP)

- ▶ Contribution to the International Height Reference Frame (IHRF).
- ▶ Contribution to the International Terrestrial Gravity Reference Frame (ITGRF)

Geodetic Products

- ▶ Weekly positions of the SIRGAS-CON stations.
- ▶ SIRGAS multi-year solutions.
- ▶ VEMOS: Velocity model for SIRGAS.
- ▶ Tropospheric Zenith Path Delays (ZPD) with an hourly sampling rate delays (CIMA, Argentina).
- ▶ Integrated Water Vapour and Troposphere Zenith total Delay over Central and South America for climate studies (MAGGIA, Argentina).
- ▶ An operational monitoring system for the total electron content (TEC) in the ionosphere. (MAGGIA, Argentina).

Geodetic products are available but not centralized!

The strategic priorities of GGOS:

Global Geodetic Infrastructure: identify gaps, modernize, and maintenance

▶ **Strength:**

- ▶ Existing geodetic networks.
- ▶ AGGO as a GGOS core site.

▶ **Weakness:**

- ▶ Difficult to maintain due to economical reasons.
- ▶ Only one core station!
- ▶ Clear gaps in South America.

The strategic priorities of GGOS:

Standardization, Integration and Optimization: Interaction with all IAG components to provide unique standards and mutually consistent, highly reliable, and easily accessible geodetic products.

- ▶ **Strength:** Participation in the IAG Working Group 0.1.3: Implementation of the International Height Reference Frame (IHRF) and in the IAG Working Group 2.1.1: Establishment of the International Terrestrial Gravity Reference Frame

- ▶ **Weakness:** IHRF as an example...

The strategic priorities of GGOS:

Geodetic Information and Expertise

Development and maintenance of organizational intangible assets, including geodetic information, expertise, and capacity building.

▶ Weakness:

- ▶ Heterogeneous knowledge and experience (specially in physical geodesy),
- ▶ Language
- ▶ Open access to papers...

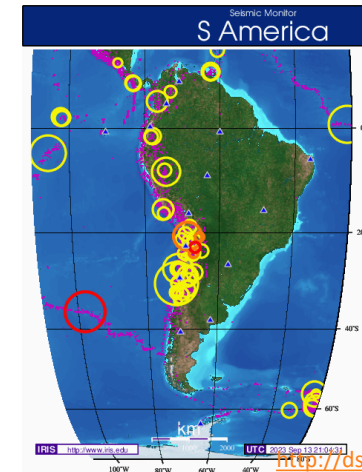
▶ Needs:

- ▶ Training programs and capacity building under a strong cooperation between GGOS and South American countries.
- ▶ Support programs of scientific visits for students and researchers of South America in center of expertise, schools, workshops and scientific meetings.

GGOS program needs a strong cooperation with geophysicists, geologists, glaciologists, oceanographers, hydrologists, meteorologists, etc. for the interpretation and modelling geodetic data

▶ Latin American and Caribbean Seismological Commission (IASPEI).

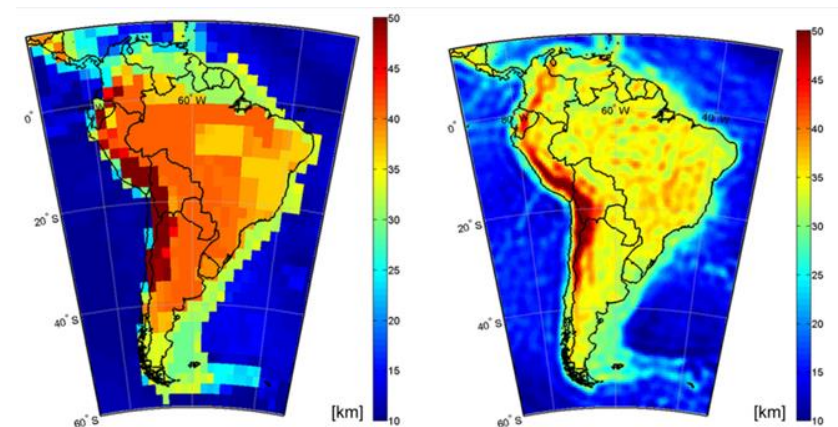
- ▶ Seismic activity
- ▶ Tsunami warning systems



http://ds.iris.edu/seismon/zoom/index.phtml?rgn=S_America

▶ IASPEI .Gravity inversion: Mapping the Moho with GOCE. Crustal modelling and Moho estimation with GOCE gravity data.

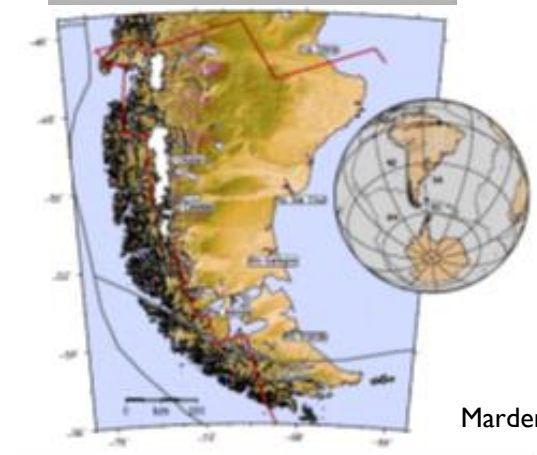
▶ IASPEI. GOCE gravity gradient data for lithospheric modelling.



https://www.esa.int/Applications/Observing_the_Earth/FutureEO/GOCE/Mapping_the_Moho_with_GOCE

GGOS program needs a strong cooperation with geophysicists, geologists, glaciologists, oceanographers, hydrologists, meteorologists, etc. for the interpretation and modelling geodetic data

- ▶ GRACE and GRACE-FO gravity variations reflect changes in the distribution of Earth's mass, including changes in Total Water Storage in river basins on land.
- ▶ Satellite radar altimetry applications in hydrology (e.g. the Amazon basin).
 - ▶ Droughts, floods...
- ▶ Products: Temporal variations of glaciers
- ▶ Satellite radar altimetry applications in glaciology .

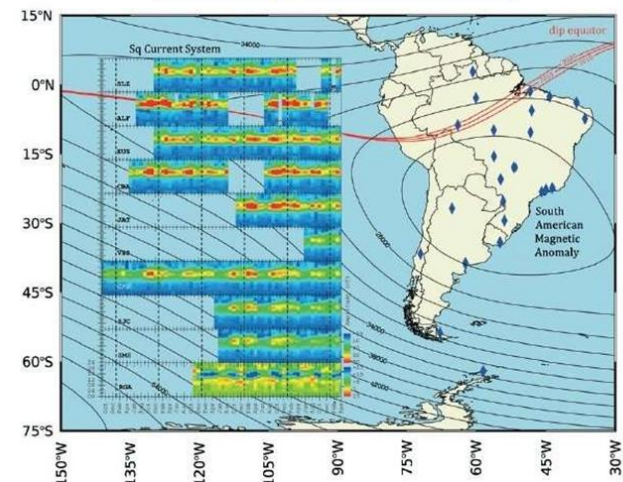


Marderwald (2020)

- ▶ International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) and IAG Joint Commission on Volcano Geodesy.



- ▶ International Association of Geomagnetism and Aeronomy (IAGA)
 - ▶ Impact of space weather



<https://phys.org/news/2018-05-network-space-weather-south-america.html>

Future perspectives

- ▶ To involve the GGOS in South America to achieve a more complete understanding of the society, science deficiencies and needs.
- ▶ To enrole all the geodetic community with Global Geodesy.
- ▶ Cooperation with other geoscientists and generation of interdisciplinary products.
- ▶ Training of young scientists.

How?



Thanks for your attention!