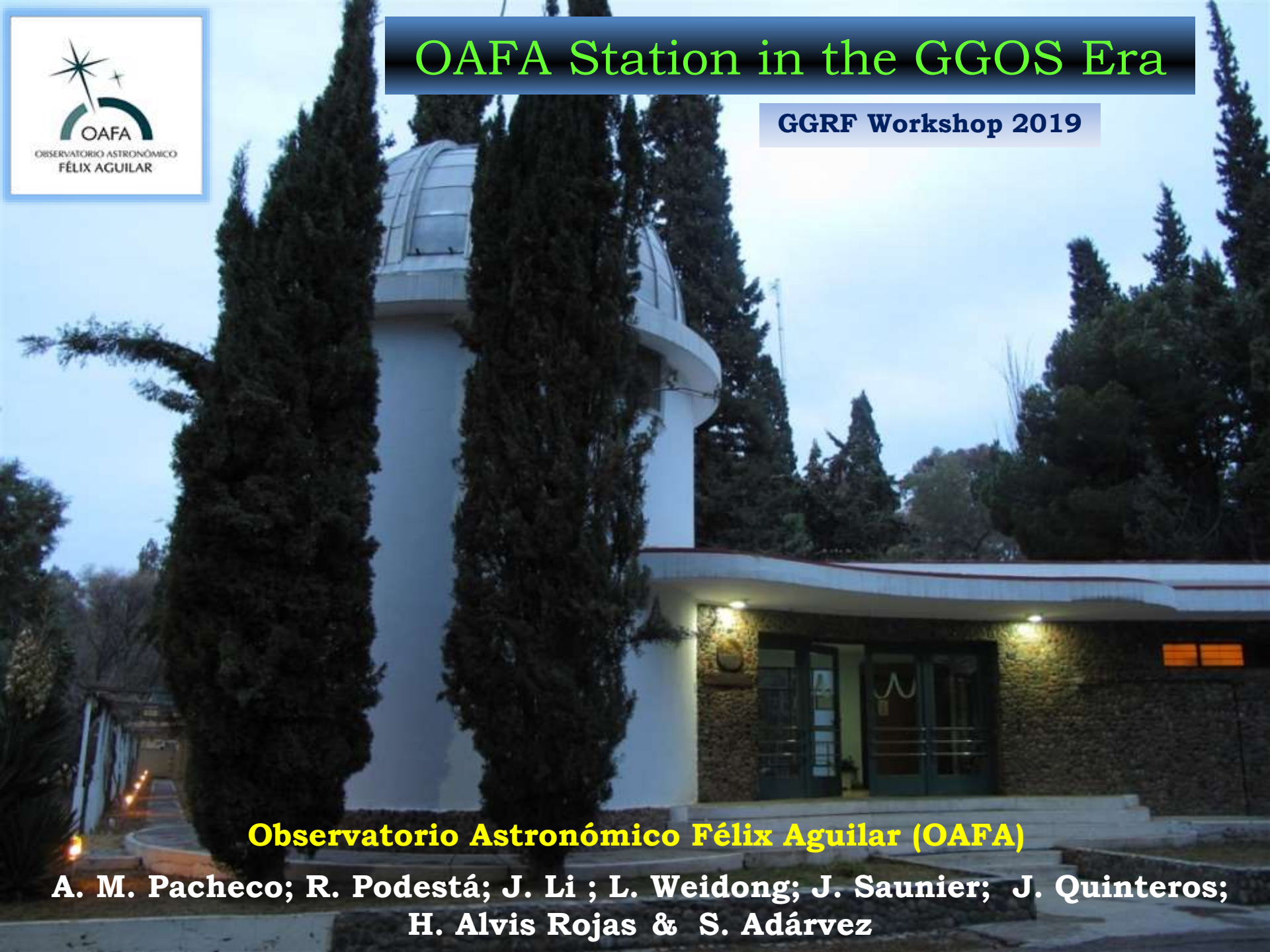


OAFA Station in the GGOS Era

GGRF Workshop 2019

Observatorio Astronómico Félix Aguilar (OAFA)

A. M. Pacheco; R. Podestá; J. Li ; L. Weidong; J. Saunier; J. Quinteros; H. Alvis Rojas & S. Adárvez

Astrometry  Geodesy

Space Techniques of Measurement

AGGO
VLBI

AGGO
GNSS

OAFA
SLR

OAFA
DORIS

First SLR Station in Argentina: SAN JUAN ILRS 7406

- International agreement between San Juan National University (UNSJ) and the National Observatories of China (NAOC) of the Chinese Academy of Sciences (CAS)

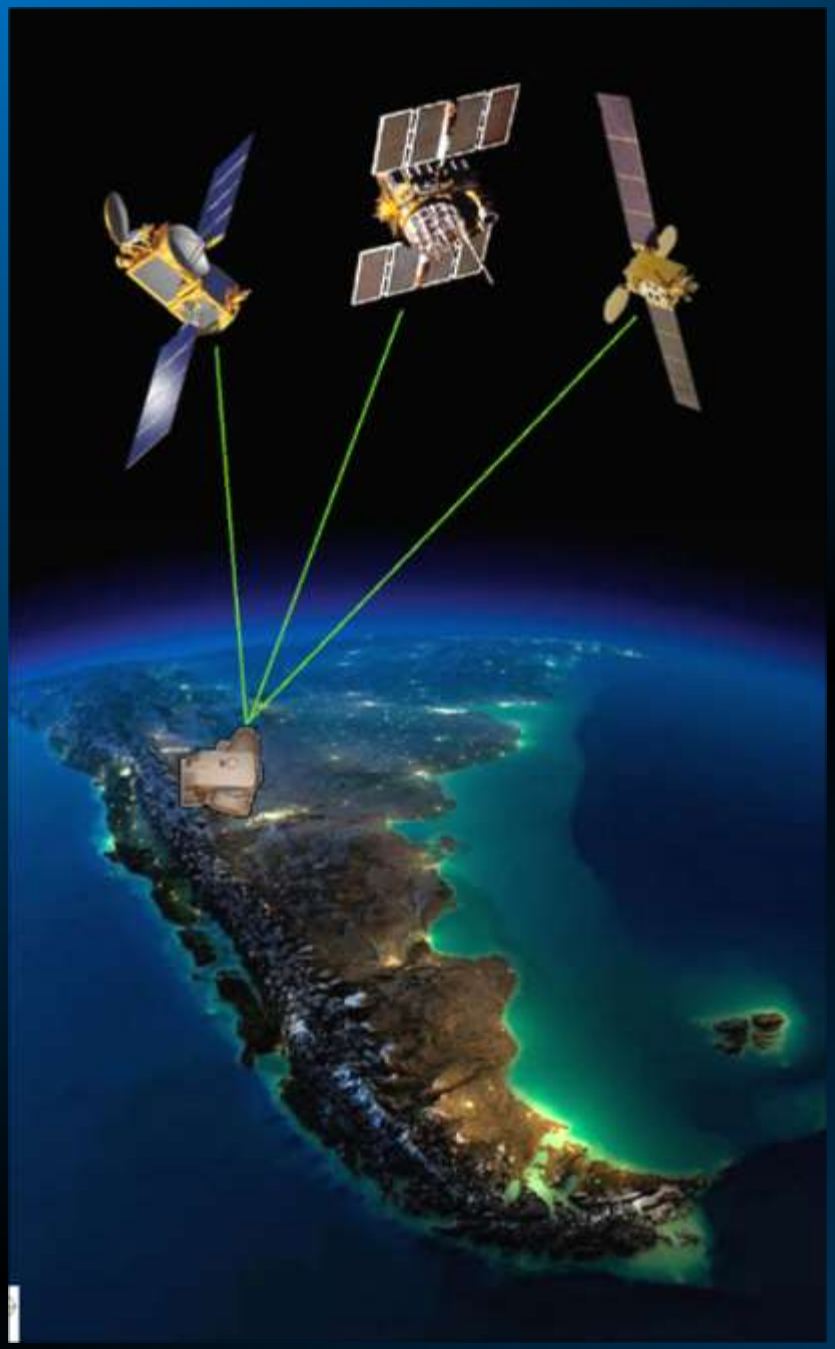
- Officially started on February 2006 and the ILRS provided the code 7406

First South American SLR Workshop (2009)
San Juan Argentina

South American stations:

- 7403 Arequipa (1989)
- 7405 TIGO (2002)
- 7406 San Juan (2006)

Attended the meeting (25 peoples)



SLR 7406 works published

Magazines = 7
Conferences and Meetings = 35

* Earth Orientation Parameters (EOPs)

* Polar Motion

* Length Of the Day (LOD)

* Earth Rotation

* Geodynamics Studies of the South American Stations

* SLR Tracking to GNSS Constellation

Thanks SIRGAS !!!!

GPS Permanent Station

Our GPS EP was incorporated into the RAMSAC - IGN network
The next step is the installation of a new triple frequency EP (including Beidou constellation).

Our permanent station began operating in 2012

Also based on an agreement with the Chinese Academy of Sciences

In 2013 we did a very good job of co-localization SLR – GPS with the accuracy required by the IERS

New DORIS Station in Argentina (2018)

New agreement between UNSJ and IGN and Spacial Agency of France

Colocations tasks SLR-GNSS-DORIS

French engineer helped by students of surveying and astronomy

Optimum place for DORIS transmitter at OAFA

The location was moved from Santiago to San Juan.

Similar sky coverage in Santiago and San Juan

Global Geodetic Observing System (GGOS)

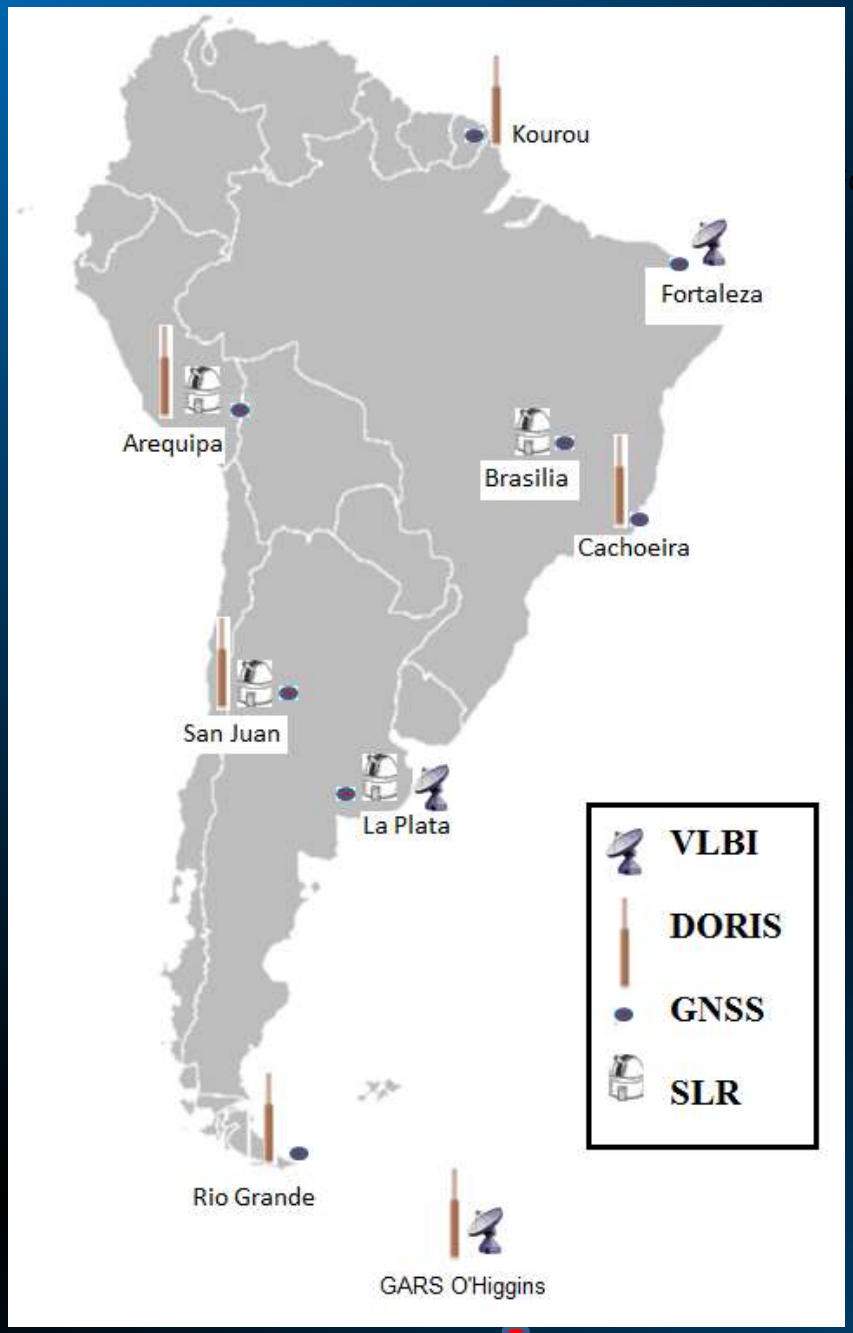
This year we receive the certificate from the IUGG as a station belonging to the GGOS network

- There are 20 stations distributed on the planet operating in the GGOS
- There are 4 GGOS stations in South America, two are Argentina (OAFA and AGGO)

Chronology of San Juan within SIRGAS :

- 2010 Invitation to SIRGAS for Dr. Claudio Brunini (President of the Executive Committee)
- 2012 1st Presentation of the ILRS 7406 in Concepción - Chile
- 2013 Session of Space Geodesic Techniques (Panamá)
- 2015 Dominican Republic – Santo Domingo: SLR SIRGAS Data Processing
- 2016 Group “Cuyo” (San Juan and Mendoza) to try to operate SLR data with Bernese
- 2018 Invitation to SIRGAS Mendoza for Dra. María Virginia Mackern (Vice president of the Executive Committee)

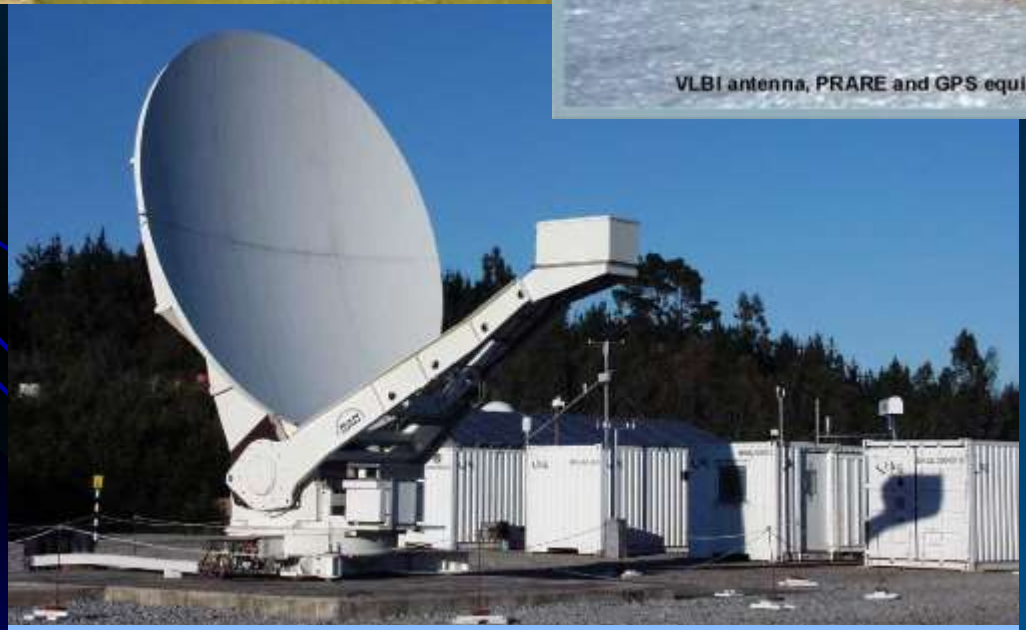
Current status of geodesic space stations in South America



- 1 station with SLR/VLBI/GNSS **(AGGO)**
- 1 station with VLBI/GNSS **(Fortaleza)**
- 1 station with SLR/DORIS/GNSS **(Arequipa)**
- 3 stations with DORIS/GNSS **(Kourou, Cachoeira and Rio Grande)**
- 1 stations with SLR/DORIS/GNSS/VLBI **(in 2020)** **(OAFA)**

El Radio Observatorio Espacial do Nordeste
ROEN (FORTALEZA)

German Antarctic Receiving Station
(GARS-O'Higgins)



AGGO Argentine-German Geodetic Observatory

China-Argentina Radio Telescope (CART)

Consist in a 40 meters telescope to be placed in San Juan for observation of radio frecuencies between 1 Ghz and 45 Ghz from the Southern hemisphere.

Station: CARLOS U. CESCO

Located in the Andes Mountain Range , 250 km by route from San Juan city

2500 meters above sea level

Under the excellent sky protected by law

The Cesco station has astrometric and astrophysical telescopes. Argentina has 40% of the time in the radio telescope

CART uses and potencial science Objectives

- Establishment and maintenance of ICRF, ITRF and SIRGAS
- To link between the frameworks of radio and in other wavelengths
- EOPs´ determinations
- Geodynamic studies of the crust of the Earth . Movement tectonic plates of the Earth.

- Study of radio and variations of structure
- Investigating the redshift of AGN
- Observations of X-ray binaries, supernovae and novae wrap.
- To study activities of solar objects, e.g. planets and asteroids
- To investigate the formation and evolution of molecular clouds
- To study the feedback of expanding HII regions
- To investigate the circumstellar medium around evolved stars.
- Hunting for Fast Radio Burst
- Timing observations of pulsars
- Investigations of interstellar masers
- Polarization of galaxy clusters
- **Contribute to space exploration, participating chinese Lunar exploration program**

Next challenges
Future Network Projects using SLR

- Seismicity in South America
- Short Arc
- Tracking GNSS
- Time transfer
- Colocalizations each three years
- Own analysis center (our calculations and data processing)

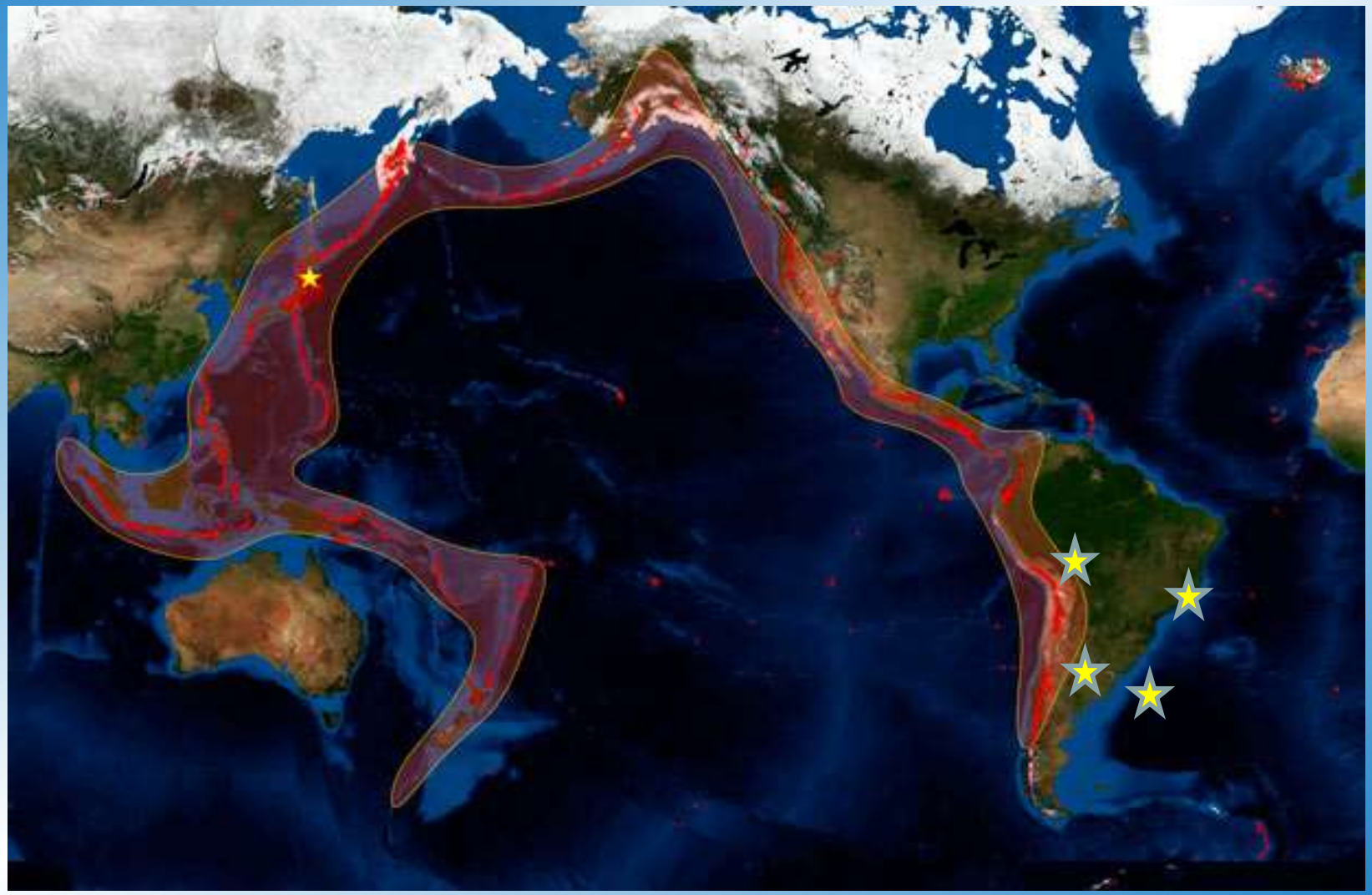
Seismicity in South America

Nazca tectonic plate is located at west of Southamerica tectonic plate

The Nazca plate is denser and is moving towards the east, thus gets downs of the South American plate.

South América is part of the RING OF FIRE

The Ring of Fire has 90 % of the world seismic activity



We have two SLR located in non-seismic zones and other two in seismic zone. Telecopes in stable areas can be used to measure displacements

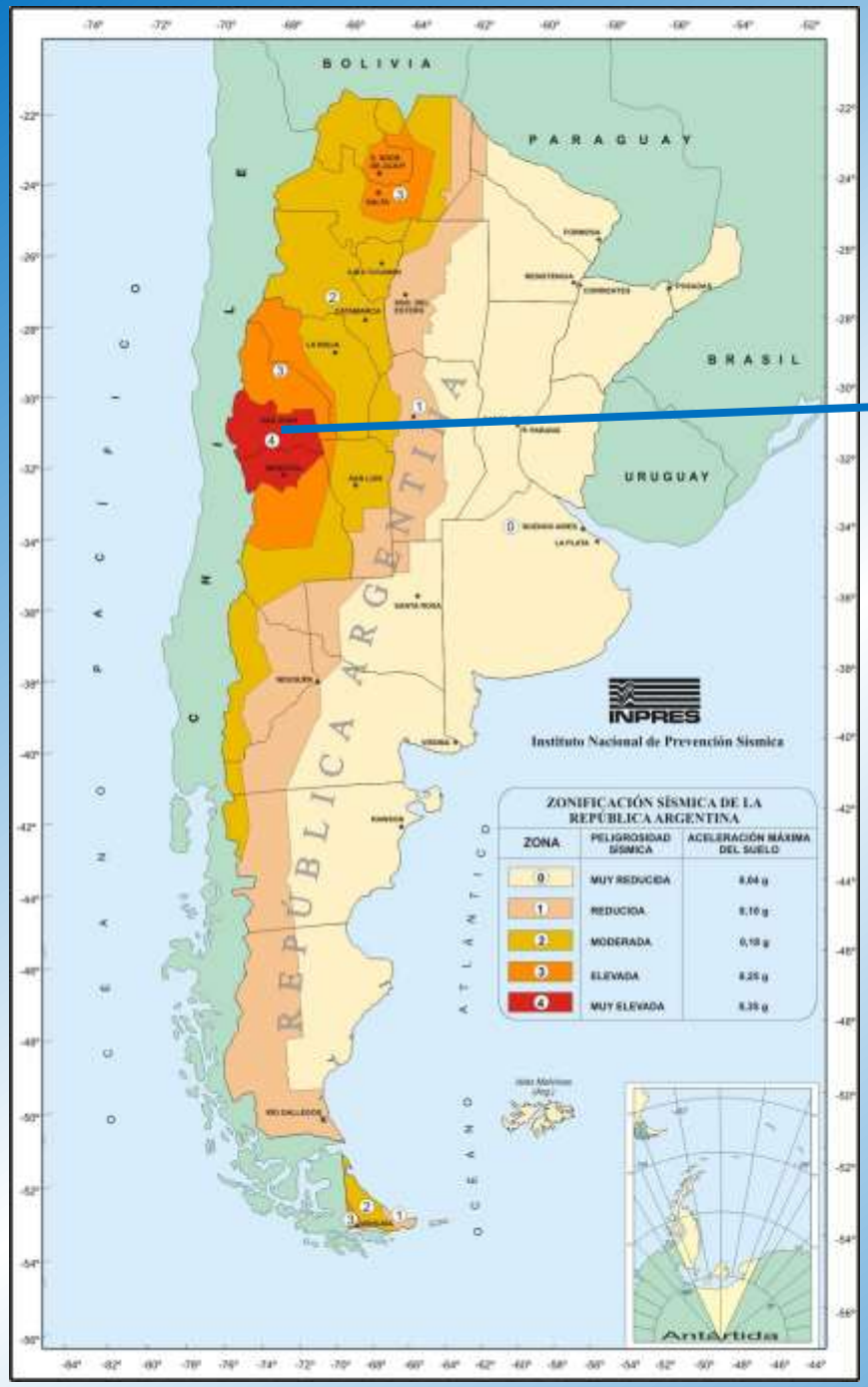
Seismic Risk in Latin America

Latin America is considered one of the most active seismic region of the world, in which the earthquake danger threatens, within large portions of the continent, all human life.

SLR can to monitoring tectonic movements

Question: Is it a good way to research local phenomena?

We used Chinese software to process SLR data and to calculate TIGO displacement in Feb 27/2010



San Juan has the maximun level of seismic hazard.

We have the highest level of probability of occurrence of large earthquakes

(2018 = 3005 earthquake registered)

Short-Arc Method

This technique consists of the possibility of tracking the same satellite simultaneously from two (or more) SLR stations and process only the simultaneous data.

LAGEOS Satellite

Baseline AGGO - OAFA

- **Sinclair and Appleby showed that this technique has great potential for accuracy, especially for monitoring the baseline between participating stations.**
- **Precision of 2-3 mm in the length of the base lines.**
- **This methodology has the limitation of the distances between stations, of 1500 km**

	Approximate distance	Order of precision
SAN JUAN - LA PLATA	1050Km	mm
AREQUIPA – SAN JAN	1700Km	mm
LA PLATA – BRASILIA	2300Km	.....
BRASILIA – AREQUIPA	2500Km	.....

Cuyo group . Viability of SLR and GNSS data processing with Bernese

In Argentina, the possibility of processing GNSS and SLR data with Bernese software is currently being studied, with the idea of including the OAFA and AGGO stations to the SIRGAS network.

Summarizing : Two good projects with SLR

- **1- Seismicity of the South American network:**
  - **Eastern stations (AGGO and BRASILIA).**
  - **Western stations (OAFA and AREQUIPA)**

Taking into account that these stations are included in the current international ITRF 2014, the constant monitoring of their coordinates is absolutely crucial due to them being located at the highest seismic activity zone of South America.

- **2- SHORT_ARC:**
  San Juan – La Plata
  San Juan – Arequipa

At the 2017 International Laser Ranging Service (ILRS) Technical Workshop, held in October in Riga, the participants issued a resolution:

Recognizing:

- **The deficiency SLR data from South America sites. Most of the stations are located in the northern hemisphere**

- **The plans by the Changchun Station to upgrade the SLR station in San Juan, Argentina**

Next month the oscillator will be changed and work will be restarted. Day and night observations, pulse repetition 1khz.

Objectives and future perspectives of the South American SLR network

a) Get to know the South American SLR stations (affiliations, personnel, equipment, functions, limitations, etc.)

b) Motivate the union and cooperation among the members for the making of joint works. Coordinate the important tasks for the network.

c) Coordinate and promote the participation of the South American SLR group in international programs.

d) Promote the network development of our own investigations and publications (**Michael Hafner**: Journal of Geodesy on Laser Ranging).

e) Promote the training and interchange of scientists, observers and students. Attend international meetings as a bloc.

f) Have our own Data Processing Center, sharing software development, progress of each station, technical innovations, etc.

Moreover this has been a successful experience in human relation because people belonging so different cultures had demonstrated they can work together with significant benefit.

First radio astronomy CART workshop and school

Primer Workshop Internacional CART
Primera Escuela CART

15 al 18 de Octubre de 2019

Observatorio Astronómico Félix Aguilar
San Juan, Argentina

Objetivos:

- **Generar el espacio de intercambio de ideas para establecer planes de trabajo a futuro.**
- **Informar acerca del aprovechamiento del CART en las áreas de Geodesia y Astronomía.**
- **Introducir a futuros usuarios en el uso del CART.**

Inscripciones Abiertas: **www.oafa.fcefn.unsj-cuim.edu.ar/cart/**

Contacto : oafa@cart.unsj.edu.ar

With the objective to elaborate proposals and ideas about future projects

El secreto del éxito no consiste en fortalecer nuestras debilidades, sino en aumentar nuestras fortalezas

The secret of success does not consist of strengthening our weaknesses, but of boosting our strengths