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GEODESY FORUM

FOR UN GGIM: AMERICAS

Geodesy in the Americas

Sonia Costa

Geodesy for Sustainable Americas

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How technology changed Geodesy science?

satellite space techniques,
powerful computers
and Internet

Past	Present
Classical methods Triangulalion, Traverse	Satellite space techniques GNSS, VLBI, SLR, DORIS
Horizontal datum(2D)	ITRS/ITRF (3D)
Local	GLOBAL
Coordinates	Coordinates and Velocities Data, Products and Services

Why do we need to change?

Geospatial information interoperability for the societal benefits
For the monitoring the Earth system and global change research

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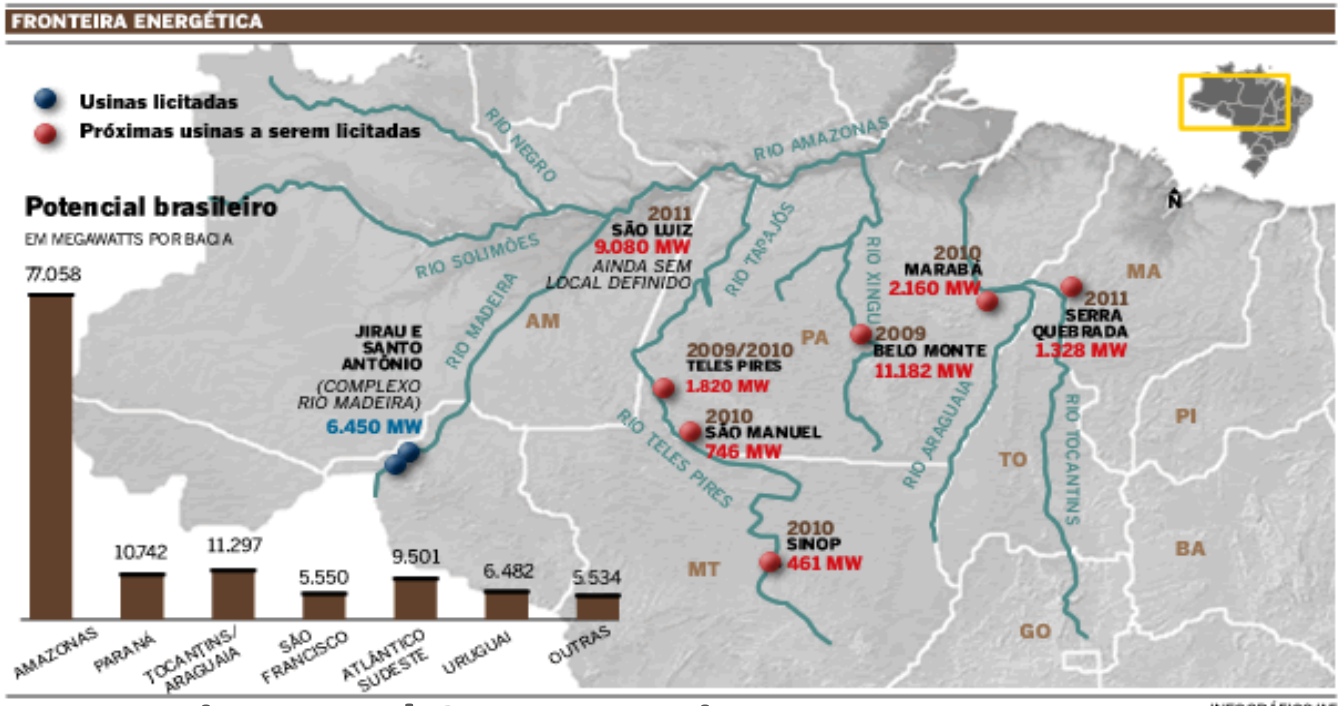
Geospatial information interoperability for the societal benefits

Provide Energy

The relevance of a unified height system for Infrastructure Projects

Hydroelectric power plants



Jirau and Sto Antonio

Itaipú Binacional

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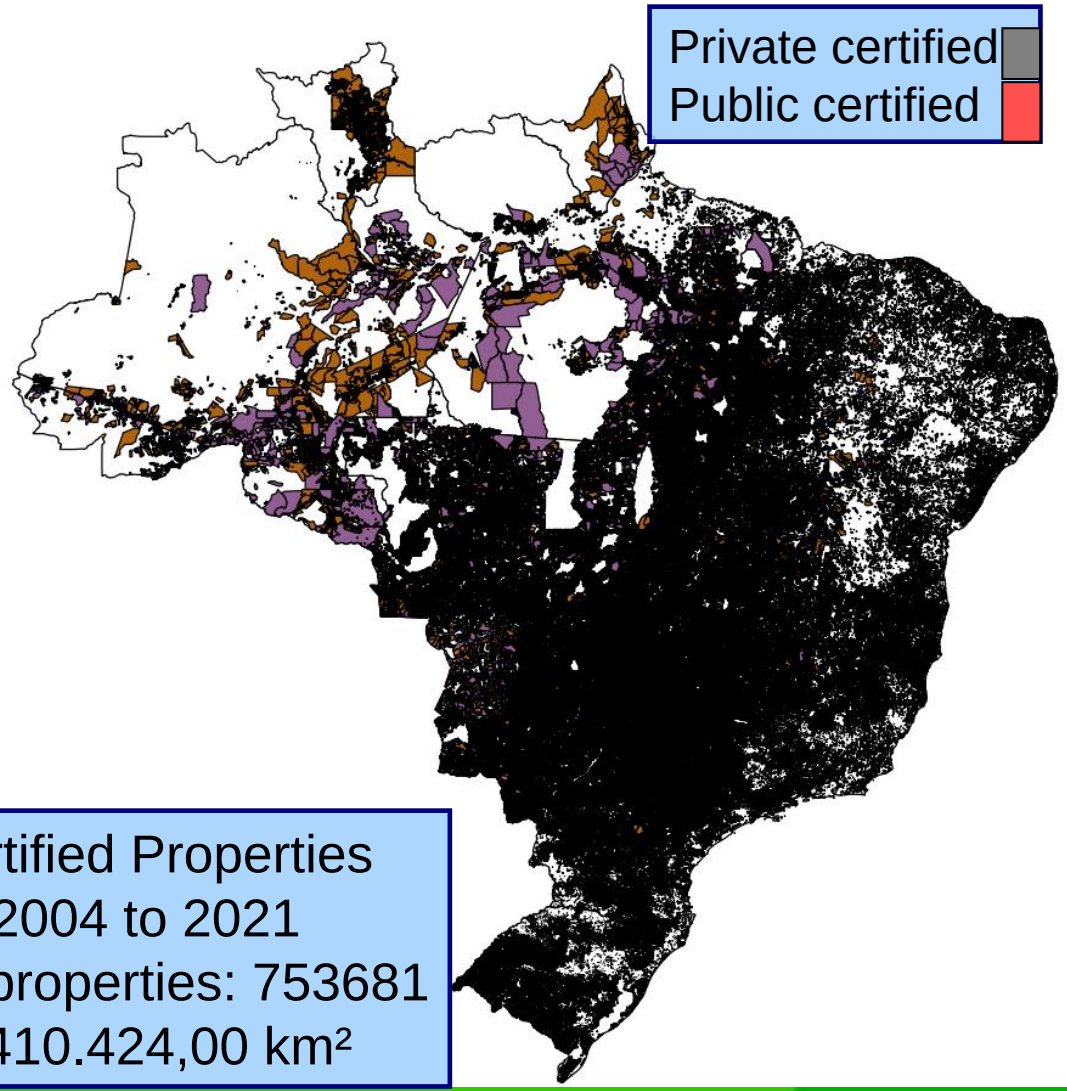
Geospatial information interoperability for the societal benefits

Land Reform

SIGEF - Sistema de Gestão Fundiária (Land Management System)

- **Brazilian Territorial Area 8.515.767,049 km²**
- **INCRA** (Instituto Nacional de Colonização and Reforma Agrária) - National Cadastre for Rural Properties
- **IBGE responsibility:** Brazilian Geodetic System
- **Law 10267/01** – Federal law that obly all owner of a rural property provide a georeferenced planta(scretch) when any prodedure related to notariat must be done.
- The georeferencing must be connected to Brazilian Geodetic System.



Certified Properties
2004 to 2021
n° of properties: 753681
3.410.424,00 km²

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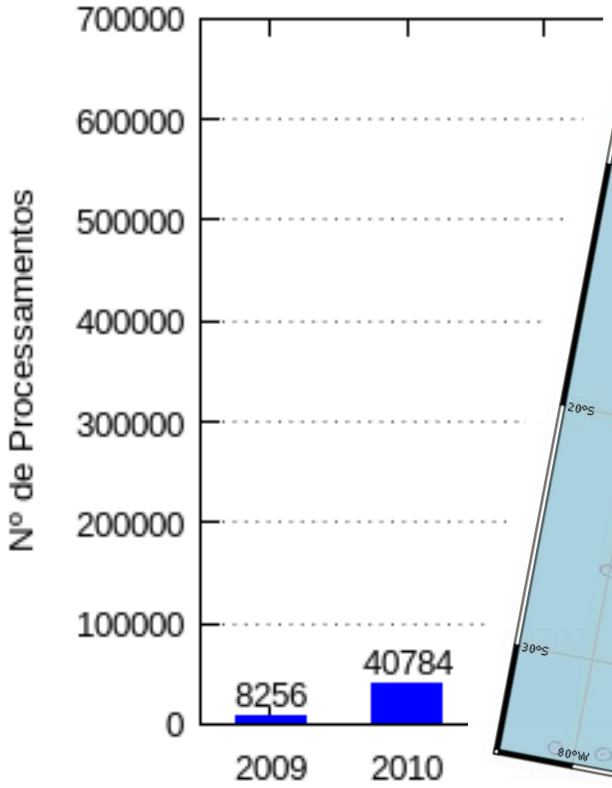
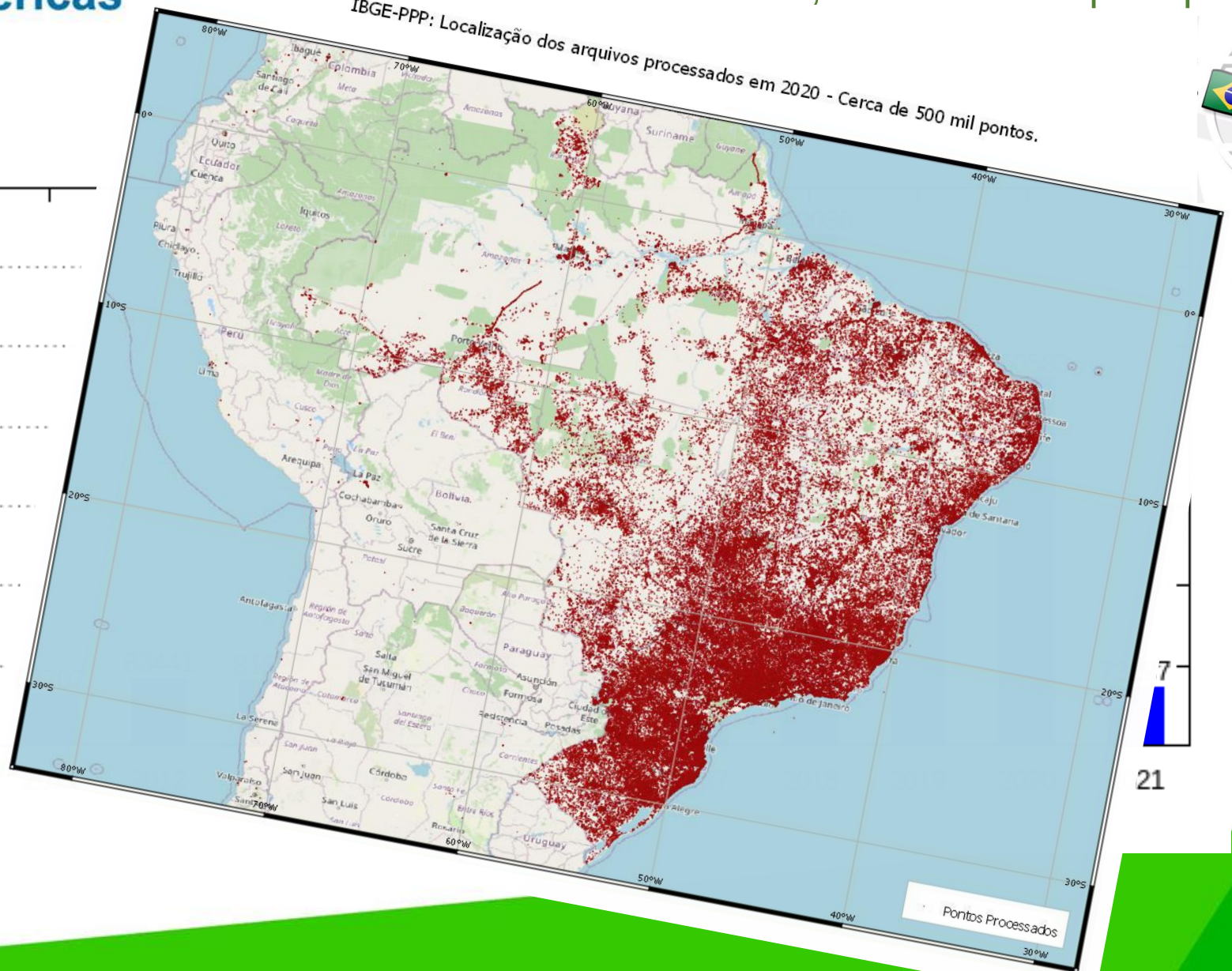
Free Web Services, online GNSS post-processing





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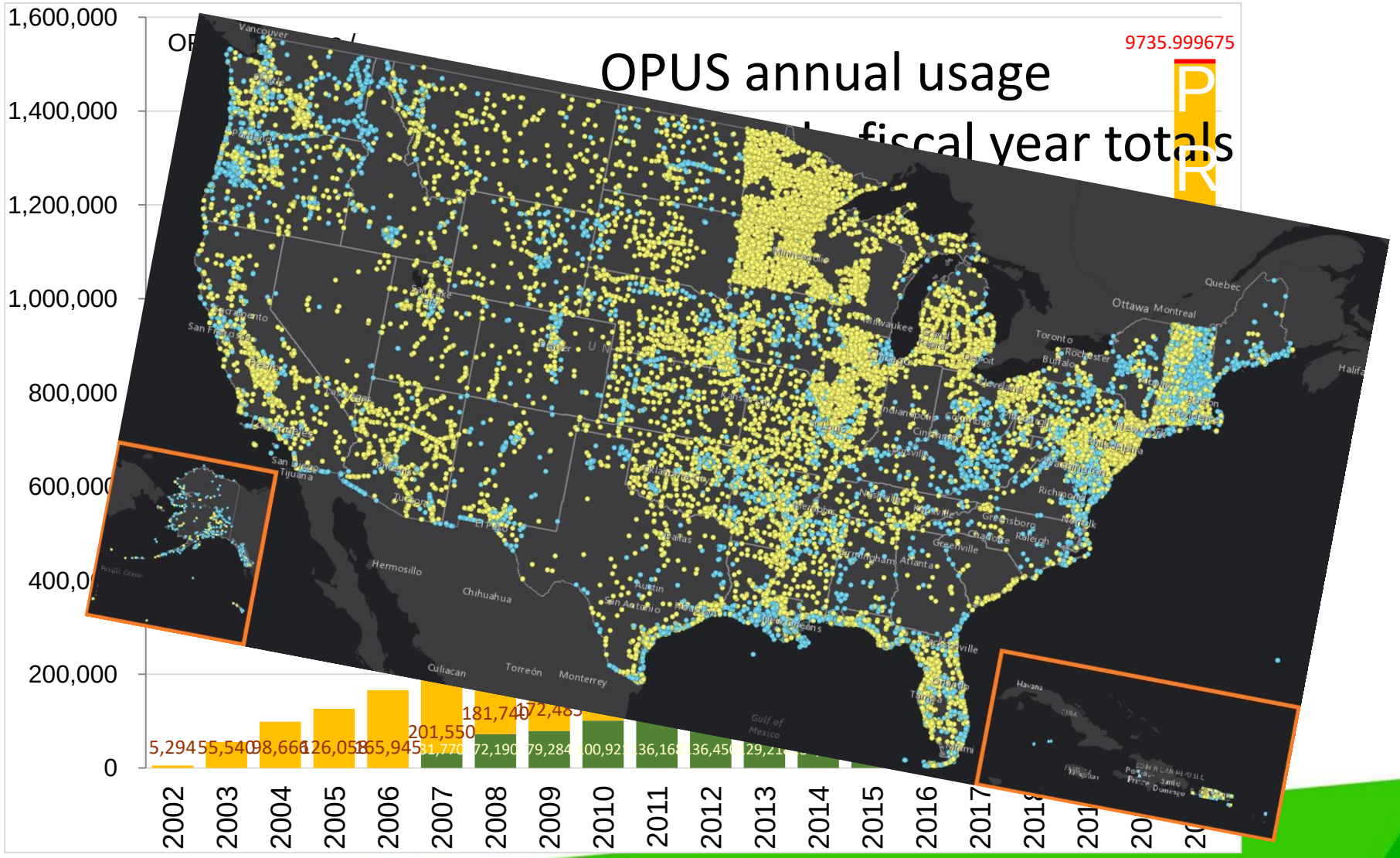
Free Web Services, online GNSS post-processing



https://geodesy.noaa.gov/web/science_edu/presentations_library/

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Geodetic Infrastructure

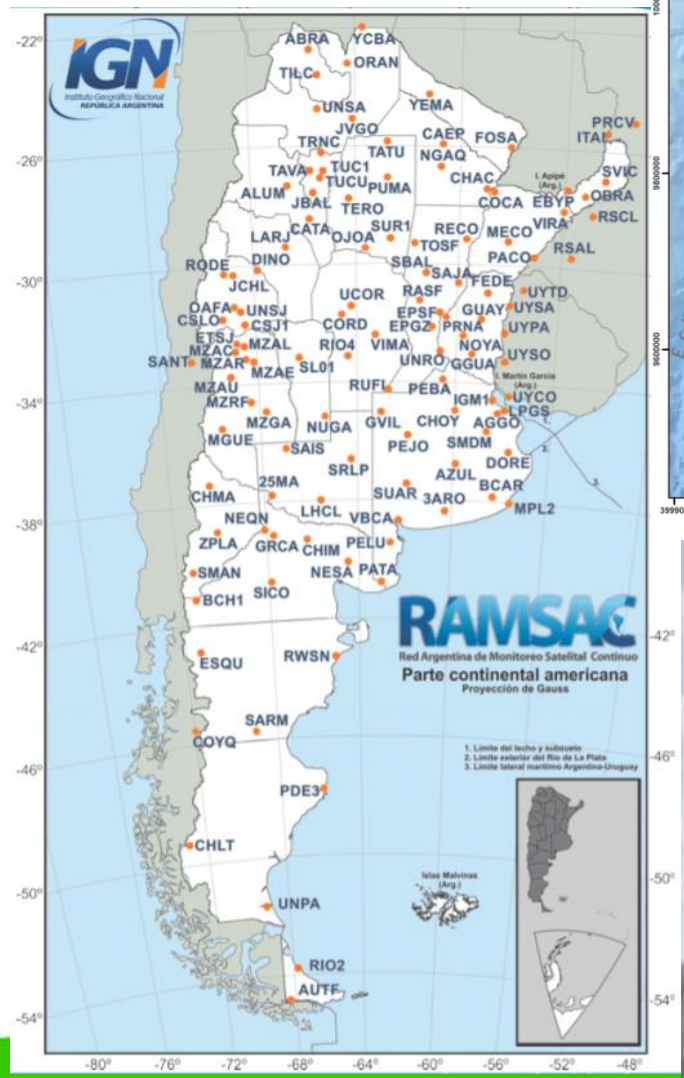
GNSS CORS Networks

GNSS Data Centers

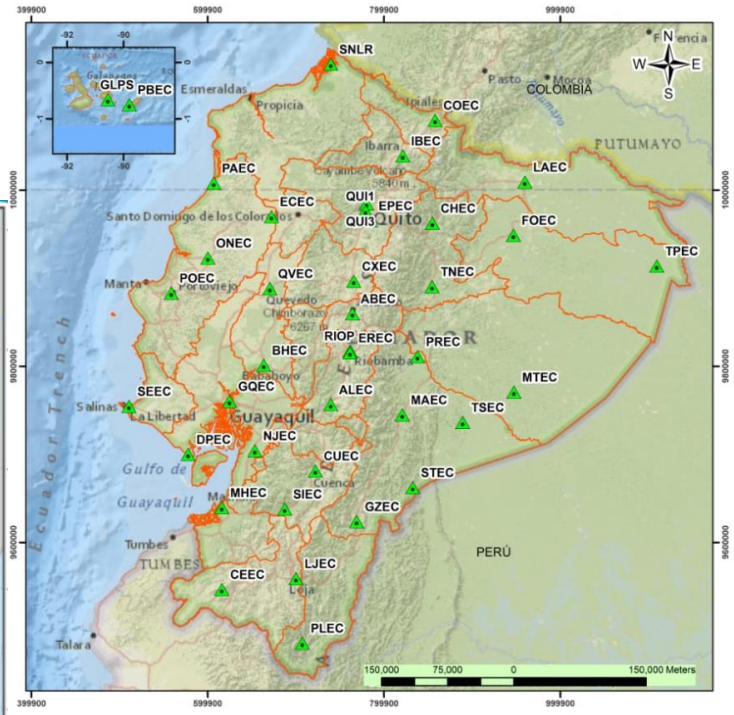
GNSS Analysis Centers

Argentina	RAMSAC
Bolivia	MARGEN
Brasil	RBMC
Chile	IGS, CSN, CAPES
Colombia	MAGNA-ECO
Costa Rica	RGNA-CR
Ecuador	REGME
México	RGNA
Panamá	Panama-CORS
Perú	REGPMOC
Uruguay	REGNA-ROU

Argentin

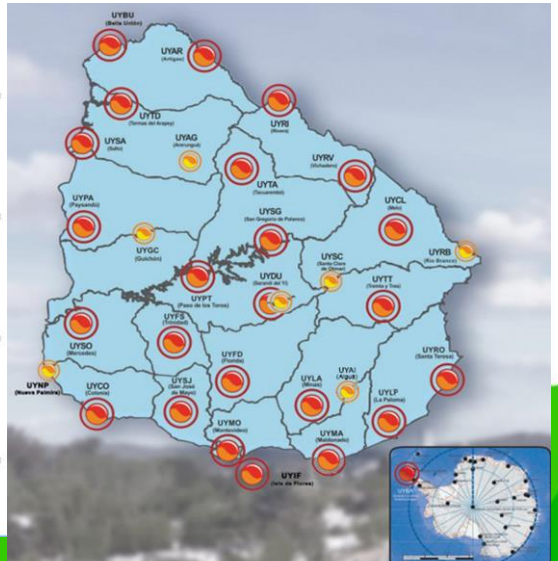


Ecuador



Urugua

y



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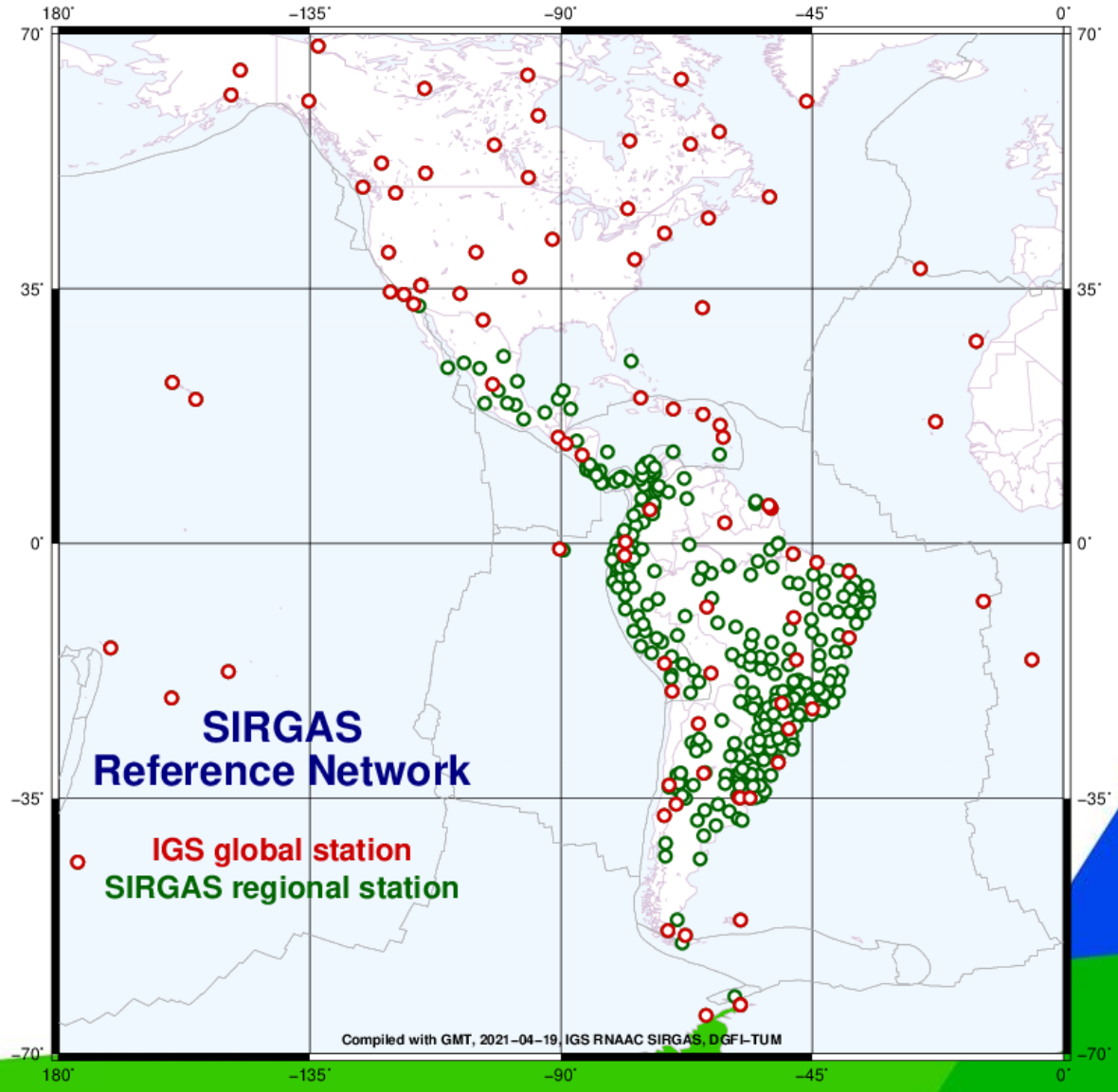
Geodetic Infrastructure
SIRGAS Reference Network

~ 440 continuous operating GNSS Network

- ✔ maintain and to ensure the long-term stability of the SIRGAS reference frame;
- ✔ accessibility to the global reference system at regional, national and local level;
- ✔ Products: weekly station positions, multi-year solutions, surface deformation models, and tropospheric parameters in hourly intervals.



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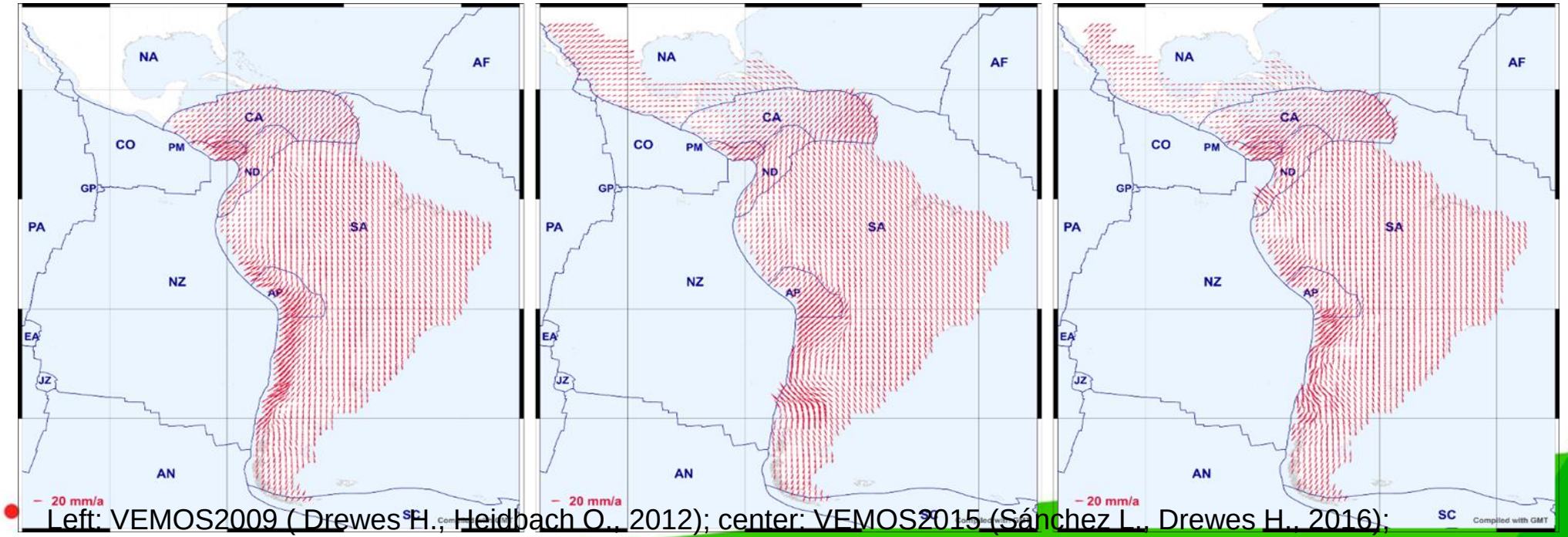
Geodetic Infrastructure
Velocity Model

Velocity model	Realizations	Region	Stations	Aplications
VEMOS2009	SIR09P01	56°S to 20°N	96 stations 400 aditional velocities	January 2, 2000 to june 30, 2009
VEMOS2015	SIR15P01	55°S, 110°W to 32°N, 35°W	456 stations	March 14, 2010 to abril 11 2015
VEMOS2017	SIR17P01	55°S, 120°W to 32°N, 35°W,	515 stations	January 1, 2014 to January 28, 2017



Left: VEMOS2009 (Drewes H., Heidbach O., 2012); center: VEMOS2015 (Sánchez L., Drewes H., 2016); Right : VEMOS2017 (Drewes H., Sánchez L., 2017)

Geodetic Infrastructure
Zenith Total delay (ZTD)

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SIRGAS

Sistema de Referencia Geocéntrico para las Américas (SIRGAS)

hosted by:

Tropospheric delays

Within the weekly processing of the **SIRGAS Continuously Operating Network (SIRGAS-CON)**, the SIRGAS Analysis Centres operationally estimate **tropospheric Zenith Path Delays (ZPD) with an hourly sampling rate**. These ZPD estimates are the input data for the generation of **SIRGAS tropospheric products**, which provide weekly combined troposphere estimates of high-reliability for each SIRGAS station. The station positions, as a necessary part of this analysis, are taken from the SIRGAS weekly combined solutions. Consequently, stations without estimated positions in the weekly combination are not included in the combined tropospheric solution.

The SIRGAS tropospheric products are computed by the **SIRGAS Analysis Centre for the Neutral Atmosphere (CIMA)**, which is operated by the **Facultad de Ingeniería of the Universidad Nacional de Cuyo** (UNCuyo, Mendoza, Argentina) in cooperation with the **Facultad de Ingeniería of the Universidad Juan Agustín Maza** (Mendoza, Argentina) and with support of the **Argentinean Consejo Nacional de Investigaciones Científicas y Técnicas** (CONICET).

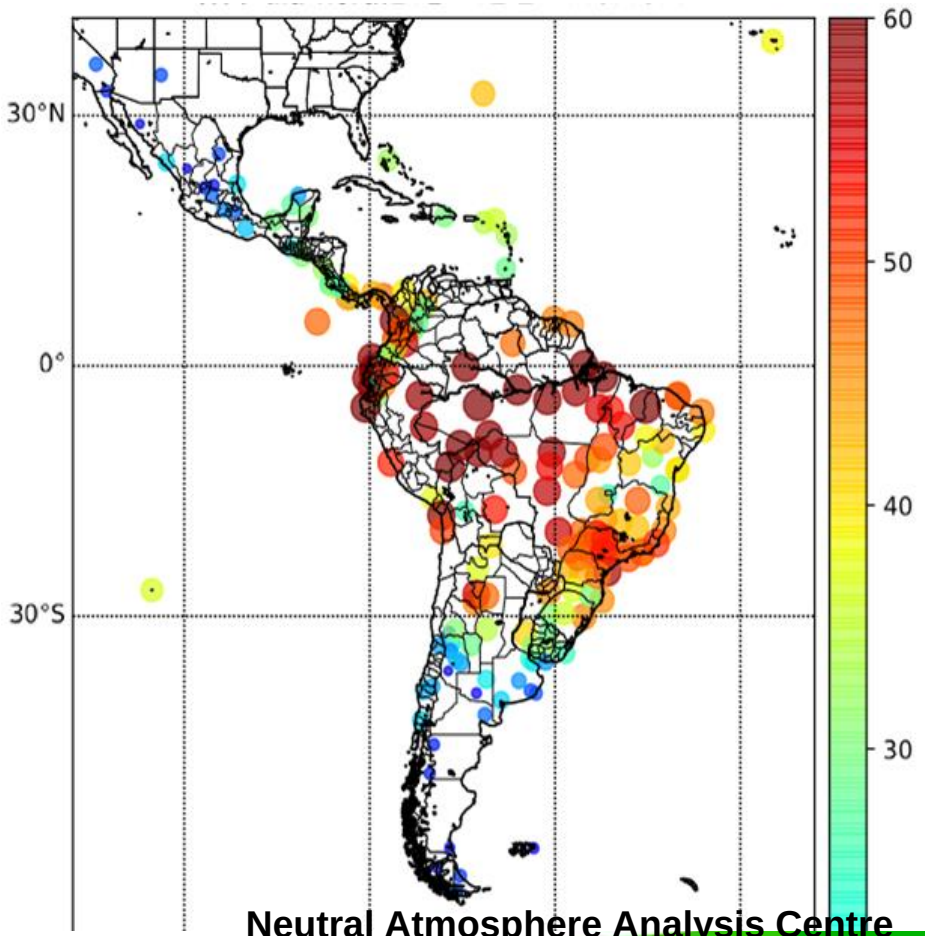
The SIRGAS tropospheric products are weekly generated with a latency of 30 days. They are available with an hourly sampling rate in daily SINEX TRO files since January 2014 and they can be downloaded from

ftp://ftp.sirgas.org/pub/gps/SIRGAS-ZPD/

More details about the processing strategy can be found at

Mackern M.V., Mateo M.L., Camisay M.F., Morichetti P.V.: Tropospheric products from high-level GNSS processing in Latin America. In: 27th IUGG General Assembly. Montreal, Canada. July 8 - 18, 2019.

Whenever you use the SIRGAS tropospheric products, please include this publication as a citation.



Neutral Atmosphere Analysis Centre

Facultad de Ingeniería, UNCuyo, Umaza, **from 2013**

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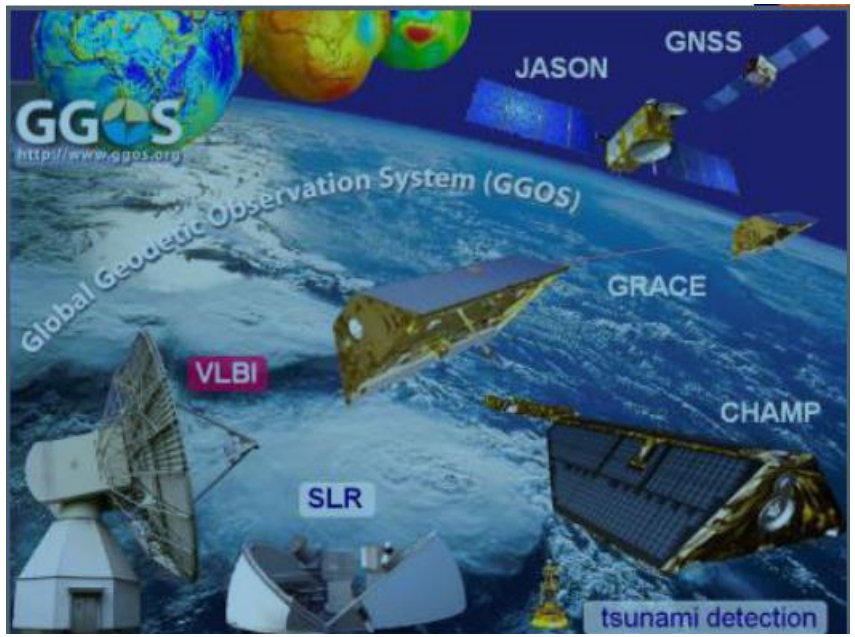
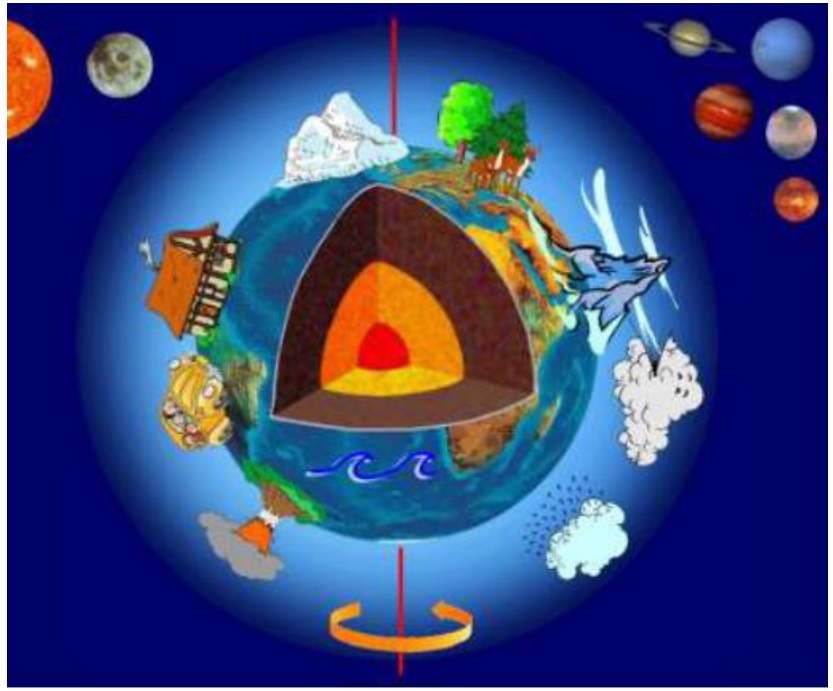
Global Geodetic Observing System of the IAG

The combination and integration of all available observations like physical measurements and geometric techniques can improve our understanding of the interactions in ”System Earth“



IAG GGOS



IAG Servives: Geometry, Gravimetry, Ocean, Standards

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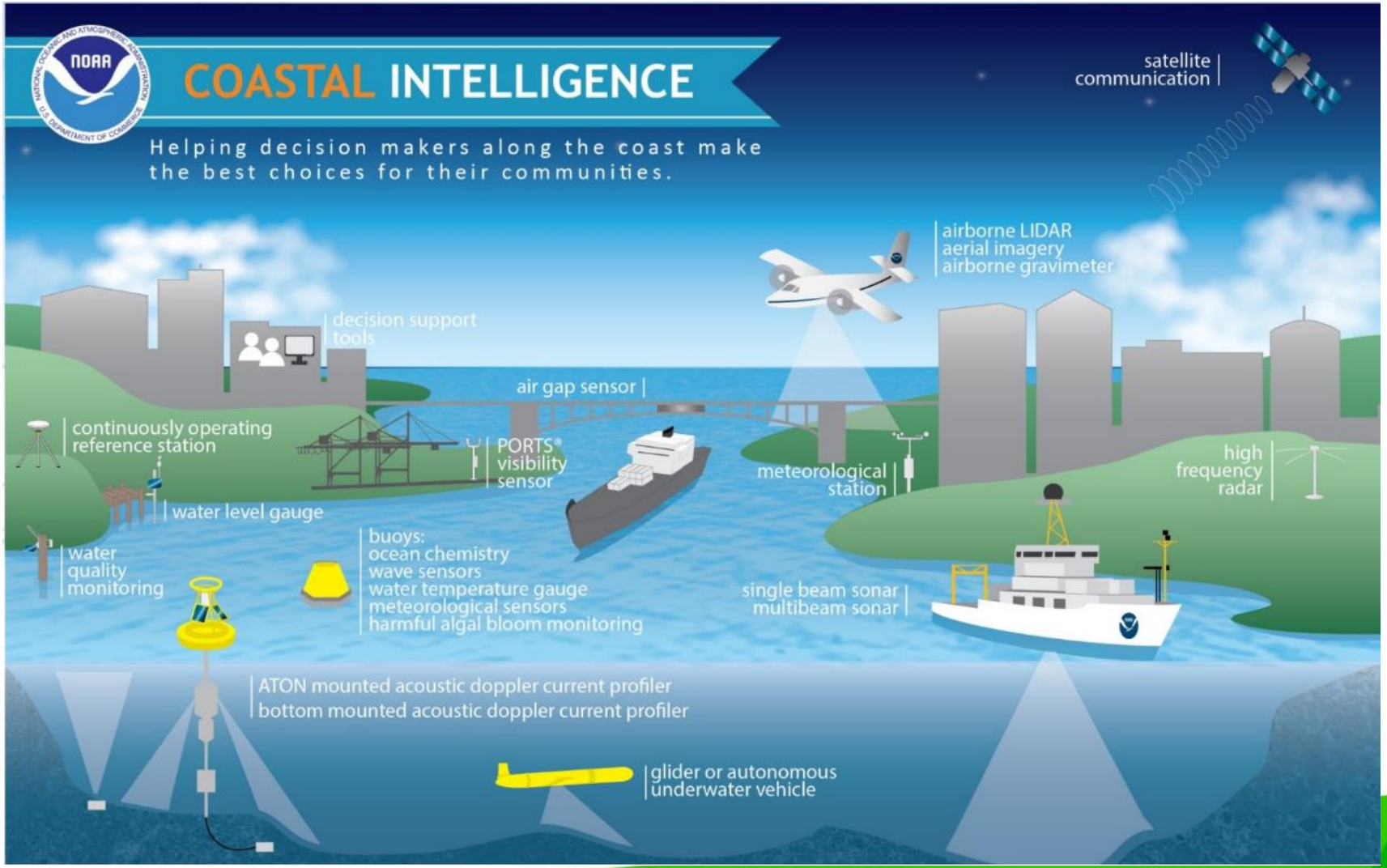
Regional and local observations – ground-based and airborne



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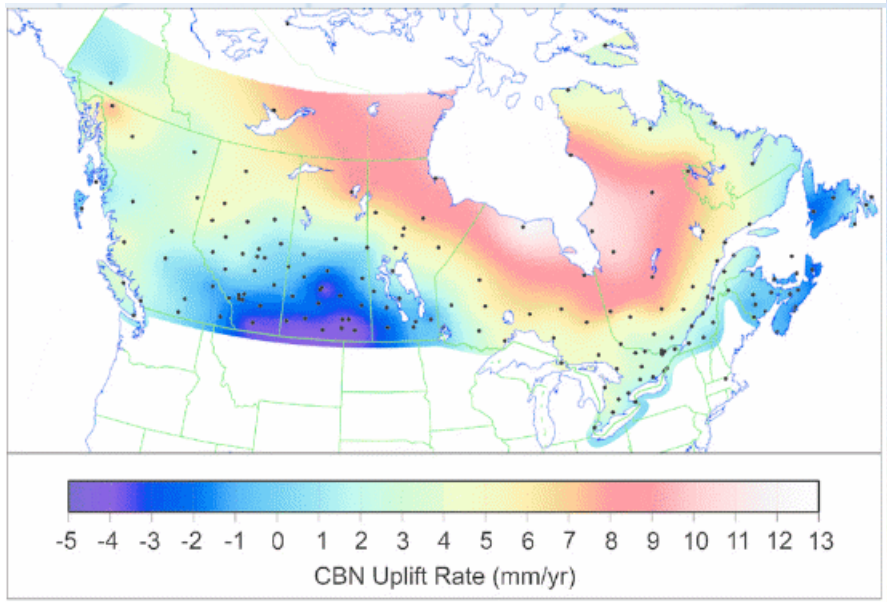
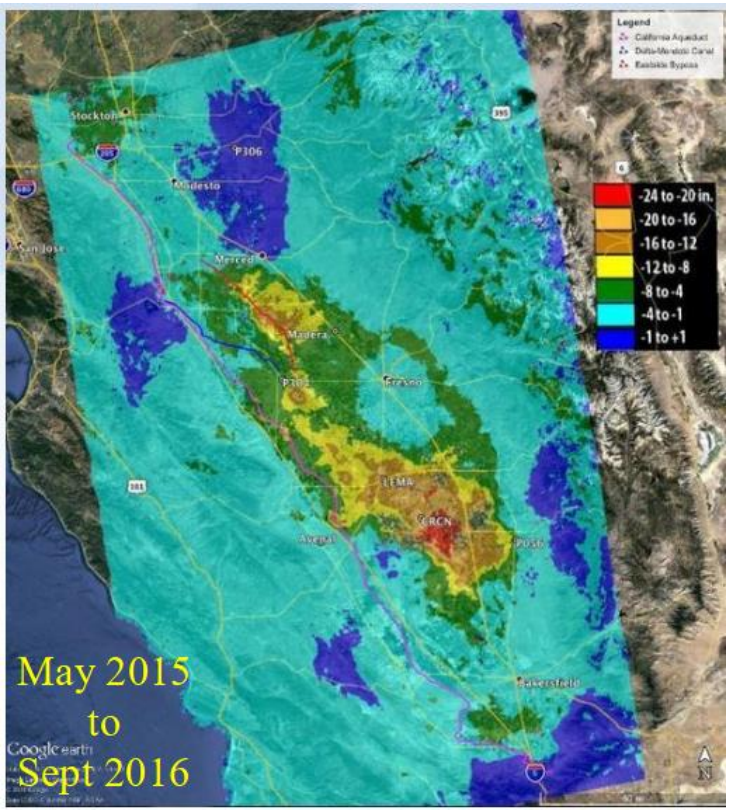
Vertical Motion

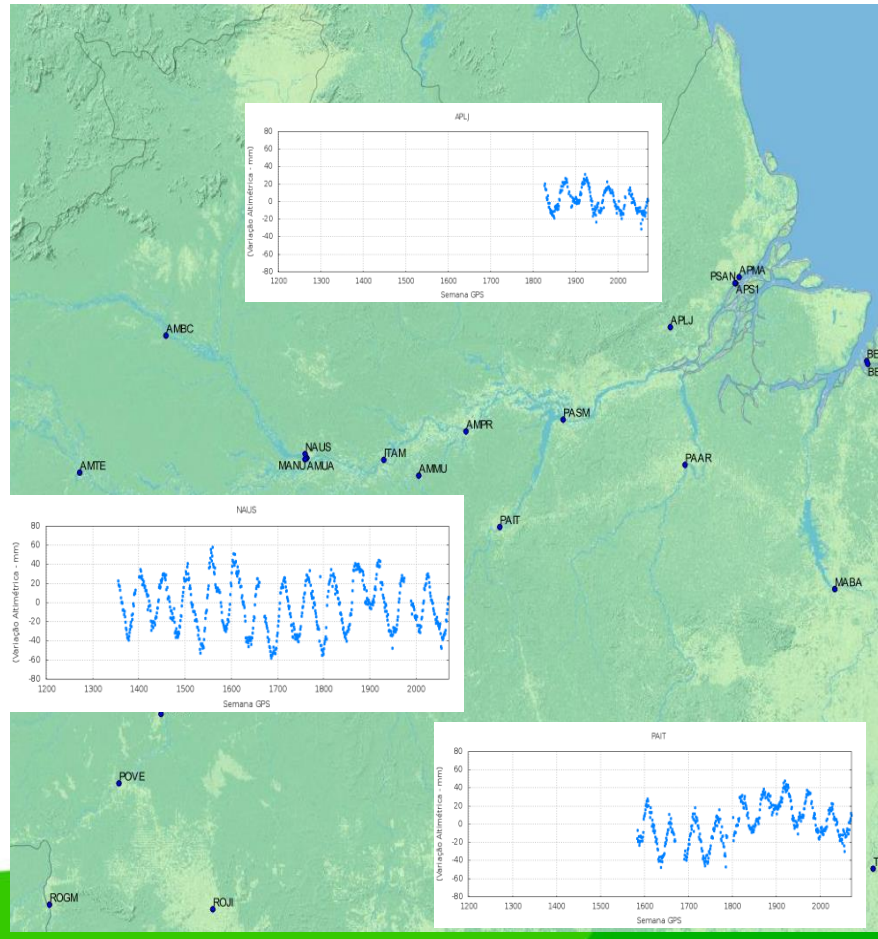


Hudson Bay Uplifting
8 – 13 mm/year



San Joaquin Subsiding
20-24” in 16 months

Seasonal Variations in the
Amazon Region
8 cm/year



https://geodesy.noaa.gov/web/science_edu/presentations_library/

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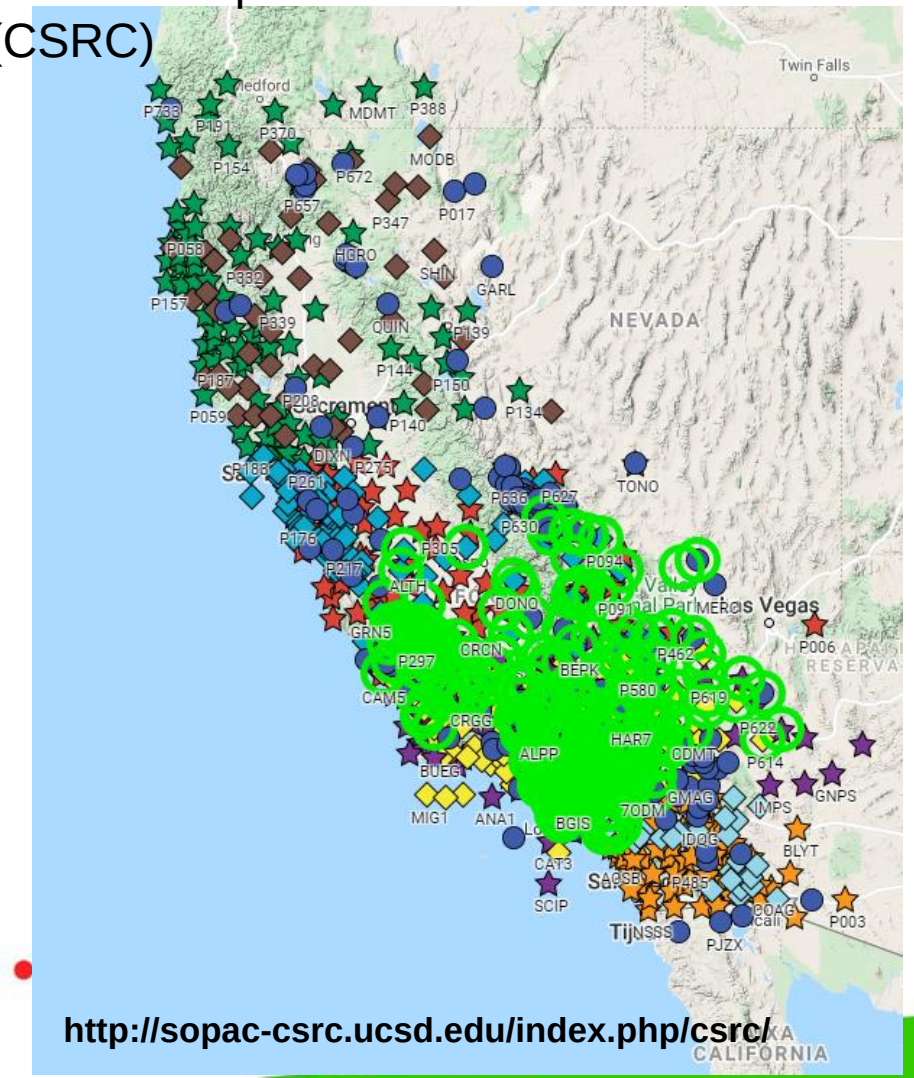
Disaster Research

California Spatial Reference Center (CSRC)



http://sopac-csrc.ucsd.edu/index.php/csrc/

Near Ridgecrest Earthquake Sequence July 4-6, 2019

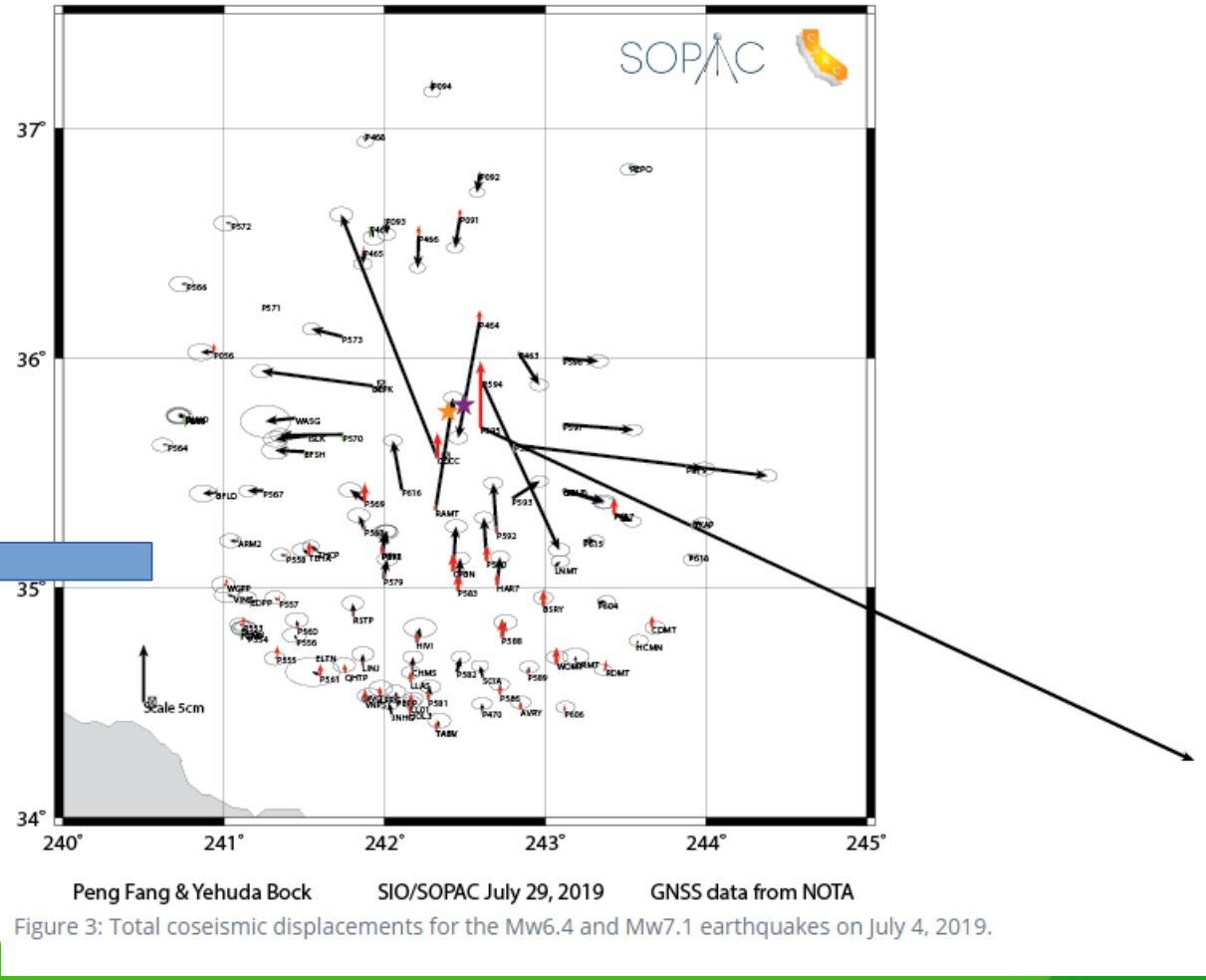


Figure 3: Total coseismic displacements for the Mw6.4 and Mw7.1 earthquakes on July 4, 2019.

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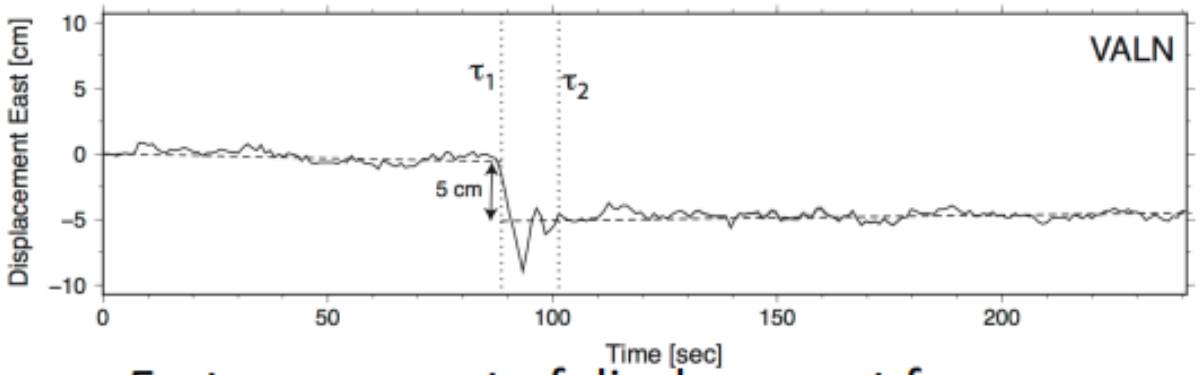
Disaster Research

CSN CENTRO SISMOLÓGICO NACIONAL UNIVERSIDAD DE CHILE

Centro Sismológico Nacional (CSN) > 130

Estimate moment magnitude and slip distribution of earthquake, ASAP!, with displacement from GNSS observations.



East component of displacement for Valparaiso Mw6.9, 2016

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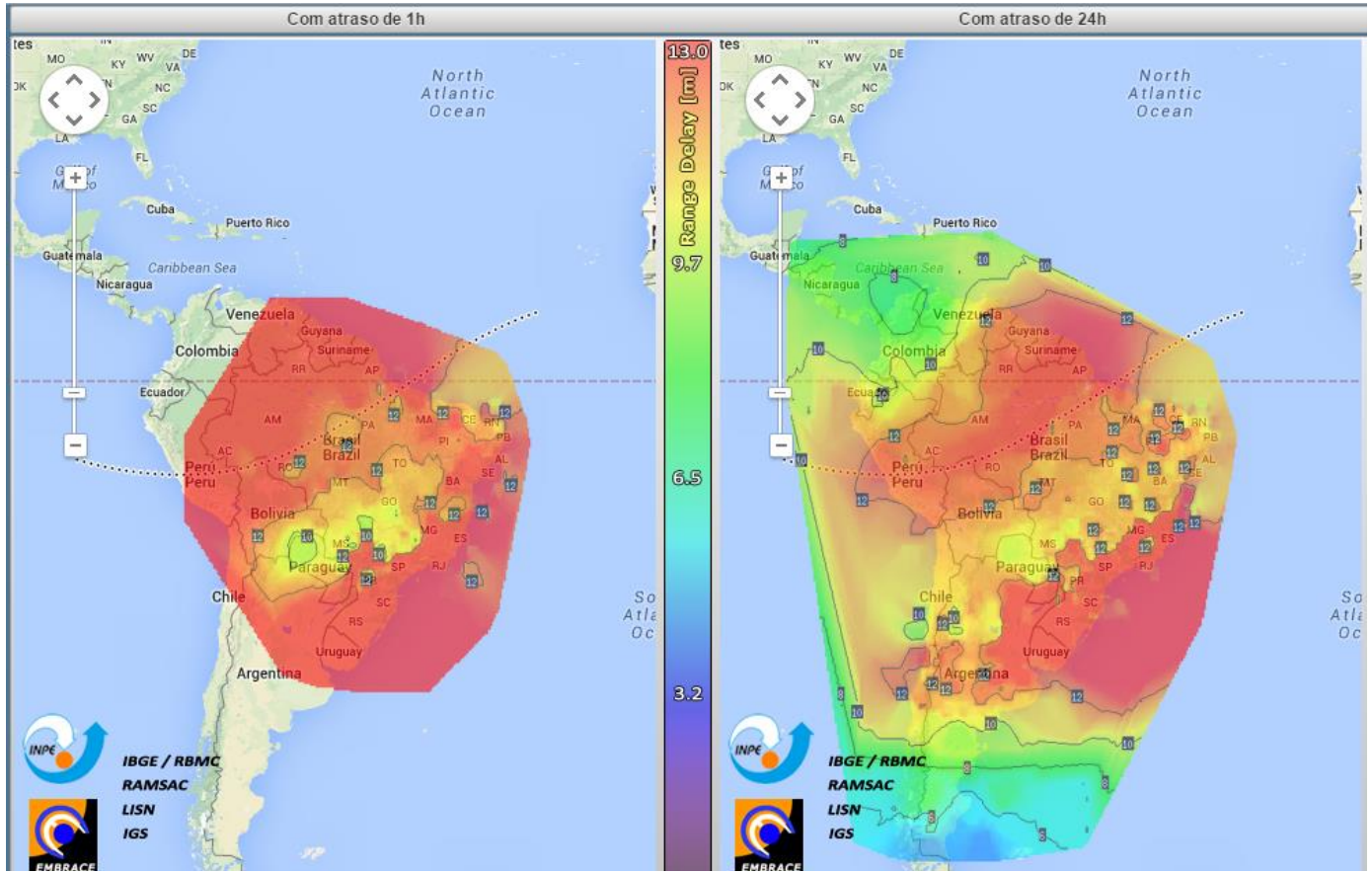
Weather Research

INPE - National Institute for Spatial Researches

EMBRACE - The Brazilian Space Weather Program



Vertical Positioning error range based on the VTEC
November 14, 2014, 19:00 UTC
1 and 24 hours delay

TEC Maps from GNSS ground stations ~140 to predict possible influence in the tecnological and economical activities.

Products : Scintillation maps(S4) and TECMAP(Total Electron Content);

TECMAP: Spatial resolution: 200 to 1000 km
Time window: 10 minutes (from real-time data) and 24 hours delay (post-processing data).

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How each contribution can help to Understand&Predict the Earth System

H. Schuh, H. Drewes, Structure, status and recent achievements of the International Association of Geodesy (IAG) and its Global Geodetic Observing System GGOS, Simposio SIRGAS 2019, www.sirgas.org

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Today's scenario in the Americas and Caribbean

Technology pushes Geodesy towards "Global Sense!"
Heterogeneous knowledge, experience, resources and infrastructure

We need to build on...

- ✔ Capacity building and training under a strong cooperation&collaboration between countries and SIRGAS;
- ✔ Clear and simple communication/outreach about geodesy and the importance of geospatial information interoperability – ITRF. IHRF and geodetic infrastructure;
- ✔ Better geodetic infrastructures: Geodetic Observatories, National CORS Networks;
- ✔ Geodetic Data Sharing for reliable models, products and services,
- ✔ Participate through IGS stations, GPSonBM, etc...

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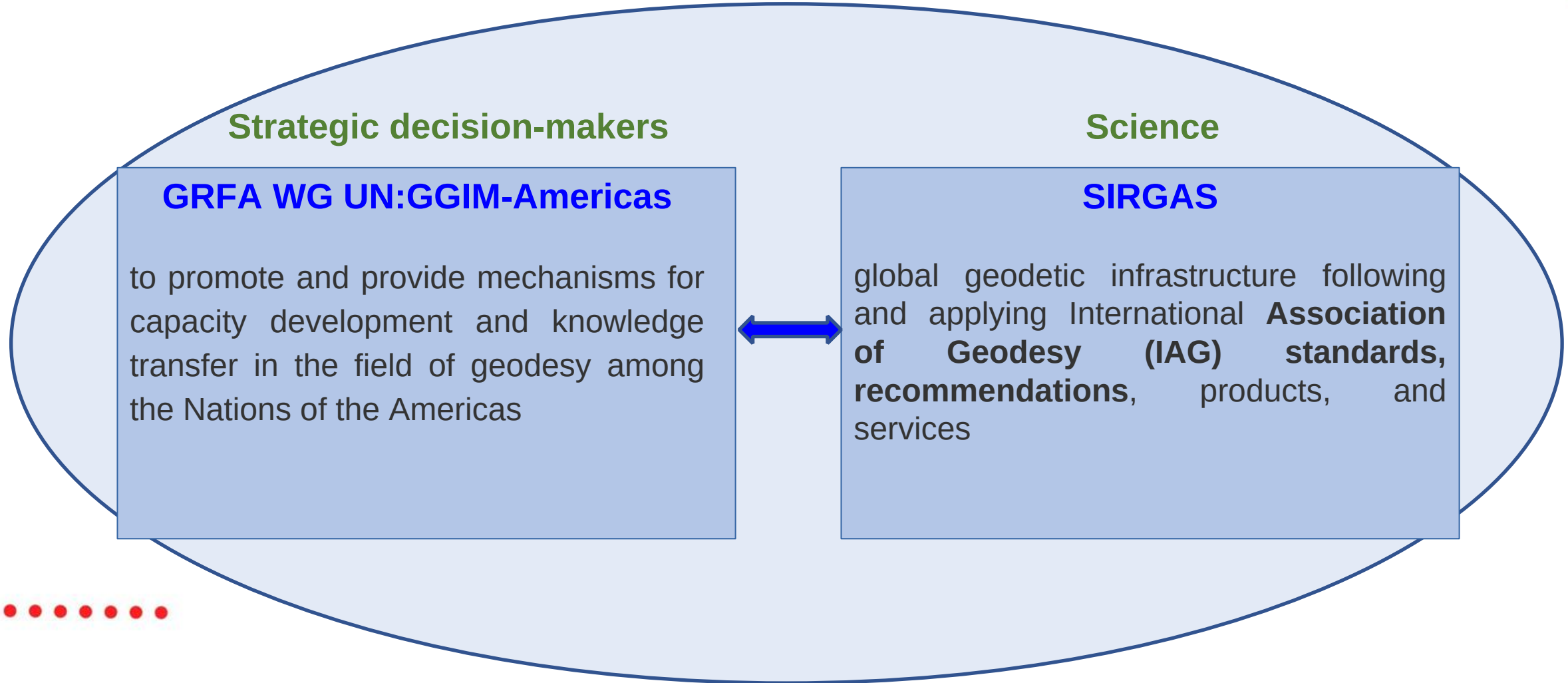
Future steps in order to advocate for and implement the Global Geodetic Reference Frame (GGRF) in the Americas for sustainable development.



THANK YOU!

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