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GEODESY FORUM FOR UN GGIM: AMERICAS Geodesy in the Americas Sonia Costa

Geodesy for Sustainable Americas



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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Free Web Services, online GNSS post-processing



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





Geospatial information interoperability for the societal benefits Land Reform

Private certified

Public certified

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



Geospatial information interoperability for the societal benefits Provide Energy

The relevance of a unified height system for Infrastructure Projects Hydroelectric power plants





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





Geodetic Infrastructure SIRGAS Reference Network



~ 440 continuous operating GNSS Network

- maintain and to ensure the longterm 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





Geodetic Infrastructure Zenith Total delay (ZTD)

- 60

MAZA

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Sistema de Referencia Geocéntrico para las Américas (SIRGAS)

		30°N	1.12-2		ζ			
Home	Tronospheric delays	50 11	. Ale		2 <u>2</u>			
Organization +								
SIRGAS reference system	Within the weekly processing of the SIRGAS Continuously Operating Network (SIRGAS-CON), the SIRGAS			and the second	· • •••		2	
SIRGAS realizations +	Analysis Centres operationally estimate tropospheric Zenith Path Delays (ZPD) with an hourly sampling rate.				- Change			- 50
SIRGAS-CON network +	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	0°	,					
	without estimated positions in the weekly combination are not included in the combined tropospheric solution.	Ū			Star Star			
SIRGAS ionospheric					ALC AL	A LE		
	The SIRGAS tropospheric products are computed by the SIRGAS Analysis Centre for the Neutral Atmosphere							
Tropospheric delays	(CIMA), which is operated by the Facultad de Ingeniería of the Universidad Nacional de Cuyo (UNCuyo,							- 40
SIRGAS-RT	Mendoza, Argentina) in cooperation with the Facultad de Ingenieria of the Universidad Juan Agustin Maza							
GGRF Workshop	(Mendoza, Argentina) and with support of the Argentinean Consejo Nacional de Investigaciones Científicas y					1		
National densifications		30°S	,			7		
SIRGAS symposia	The SIRGAS tropospheric products are weekly generated with a latency of 30 days. They are available with an	I						
	hourly sampling rate in daily SINEX TRO files since January 2014 and they can be downloaded from							
SIRGAS SCHOOLS	ftp://ftp.sirgas.org/pub/gps/SIRGAS-ZPD/							- 30
Publications					<i>K</i>			30
Presentations	More details about the processing strategy can be found at				2			
Web, Links & Contact +	Mackern M.V., Mateo M.L., Camisay M.F., Morichetti P.V.: Tropospheric products from high-level GNSS				1			
	processing in Latin America. In: 27th IUGG General Assembly. Montreal, Canada. July 8 - 18, 2019.				*	`		
hosted by:	Whenever you use the SIRGAS tropospheric products, please include this publication as a citation.			Neutra	d Atmospher	e Analysis	Cent	re
пm				Fac	ultad de Ingeniería	. UNCuvo. Umaz	za, fro	m 2013
1411						,,, _, _, _, _, _, _, _,	,	



For the monitoring the Earth system and global change research

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"



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IAG Services: Geometry, Gravimetry, Ocean, Standards



For the monitoring the Earth system and global change research Regional and local observations – ground-based and airborne



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For the monitoring the Earth system and global change research 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



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



For the monitoring the Earth system and global change research Disaster Research

California Spatial Reference Center (CSRC)

Near Ridgecrest Earthquake Sequence July 4-6, 2019





For the monitoring the Earth system and global change research Disaster Research

CSN

Centro Sismológico Nacional (CSN) > 130 Estimate moment magnitude and slip distribution of earthquake, ASAP!, with displacement from GNSS observations.





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Báez J., Red GNSS del Centro Sismológico Nacional de Chile y aplicaciones a terremotos, Simpósio SIRGAS 2019, www.sirgas.org



For the monitoring the Earth system and global change research Weather Research

INPE - National Institute for Spatial Researches EMBRACE - The Brazilian Space Weather Program



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

<u>**Products**</u>: Scintillation maps(S4) and TECMAP(Total Electron Content);

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

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



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 station, etc...

UN-GGIM:Americas

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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