



IBGE



SIRGAS 2019 Symposium

Operativity of the SIRGAS-CON network: a look at the performance of SIRGAS Working Group I during the 2015-2019 period

¹Víctor Cioce, ²Sonia Alves, ³Mauricio Gende

vcioc@fing.luz.edu.ve

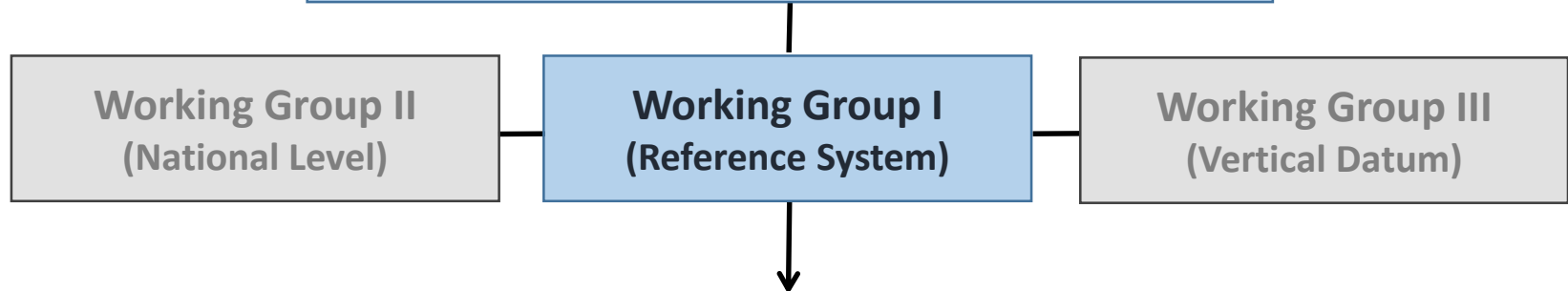
¹Universidad del Zulia (LUZ). Maracaibo, Venezuela

²Instituto Brasileiro de Geografia e Estatística (IBGE). Rio de Janeiro, Brasil

³Universidad Nacional de La Plata (UNLP). La Plata, Argentina

**November 11-14, 2019
Rio de Janeiro, Brazil**

SIRGAS (Sistema de Referencia Geocéntrico para las Américas)



Former Chairs

1993 a 2004:

- Melvin Hoyer (Venezuela)

2004 a 2007:

- Claudio Brunini (Argentina)

2007 a 2008:

- Sonia Alves Costa (Brasil)

2008 a 2015:

- M. Virginia Mackern (Argentina)

2015 a 2019:

- Víctor Cioce (Venezuela)

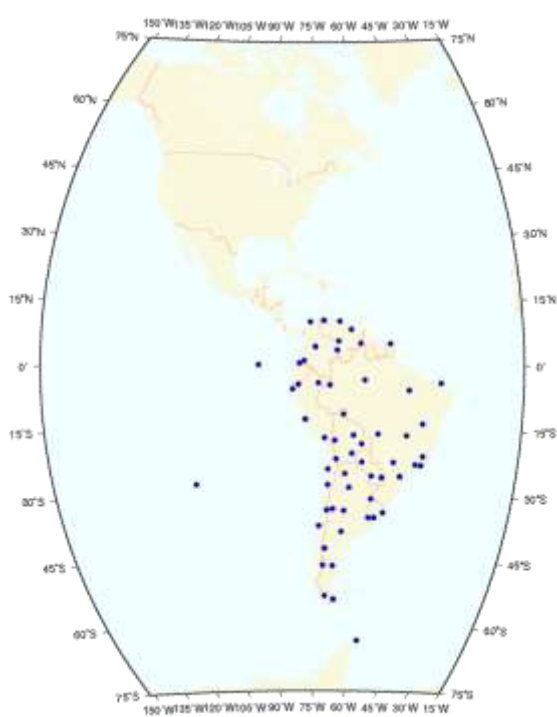
- It was created in 1993.
- Main task: to establish in Latin America a geometric reference frame consistent with the ITRF (International Terrestrial Reference System).
- First achievements: SIRGAS95 (ITRF94:1995.4) and SIRGAS2000 (ITRF2000:2000.4).
- Strategic objectives:
 - To provide an accurate densification of the ITRF for Latin America.
 - To guarantee the continuous improvement of the frame of reference.

2. The SIRGAS realizations

- The SIRGAS network grew up in a progressive way:
 - **Distribution and number of stations**
 - **Occupation mode, from passive network to continuous one**
 - **Type of observations, from GPS to GNSS**
 - **Network purposes and products**

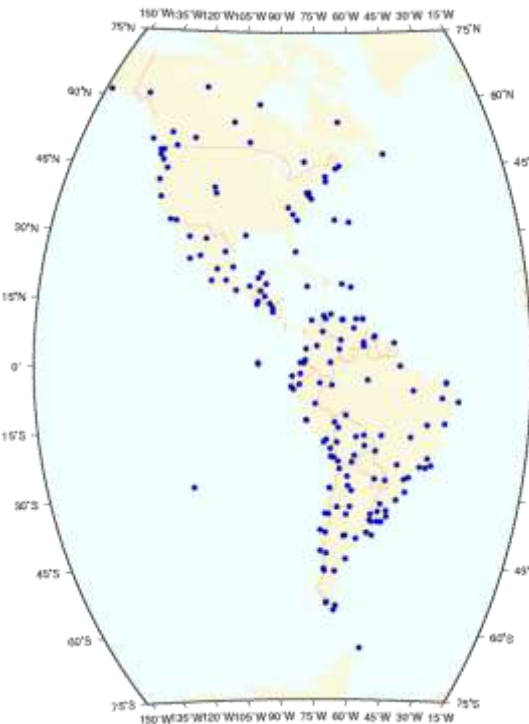


a Working Group reorganization was done



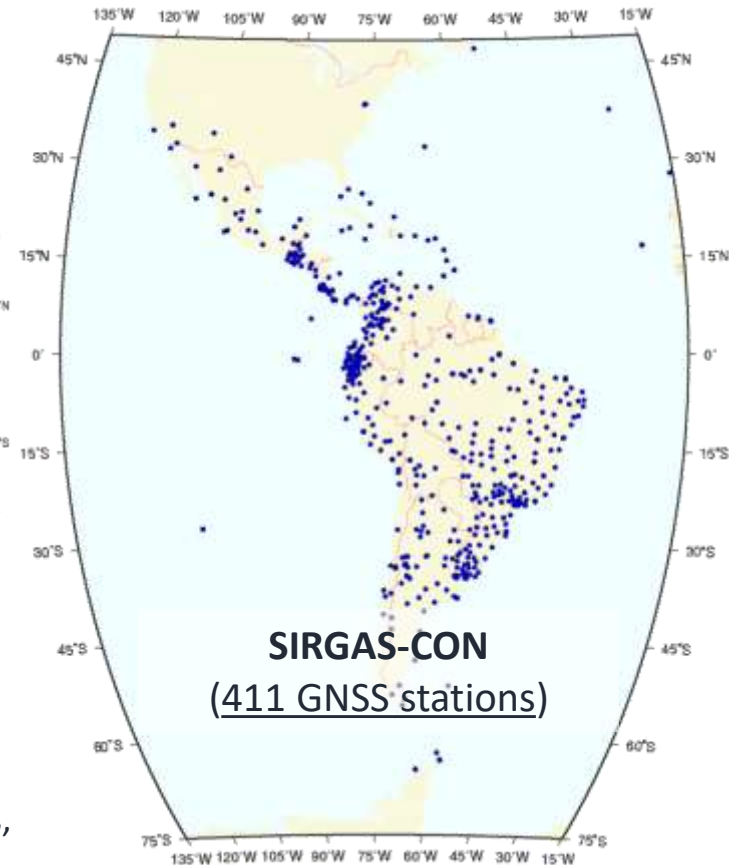
SIRGAS95

(passive network, 58 GPS stations, given in ITRF94:1995.4)



SIRGAS2000

(passive network, 184 GPS stations, given in ITRF2000:2000.0)

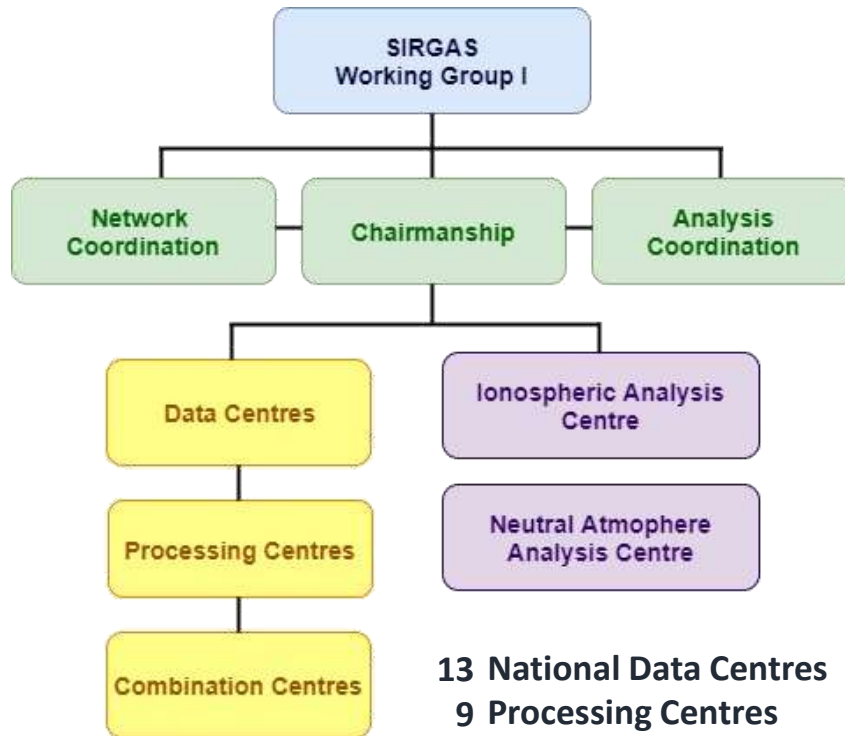


SIRGAS-CON
(411 GNSS stations)

3. The SIRGAS Working Group I (Reference System)

Working Group I (WGI) responsibilities:

- Maintenance of the reference frame through SIRGAS-CON.
- Capacity building related to the reference system/frame.
- Optimal exploitation of the SIRGAS-CON observational infrastructure.



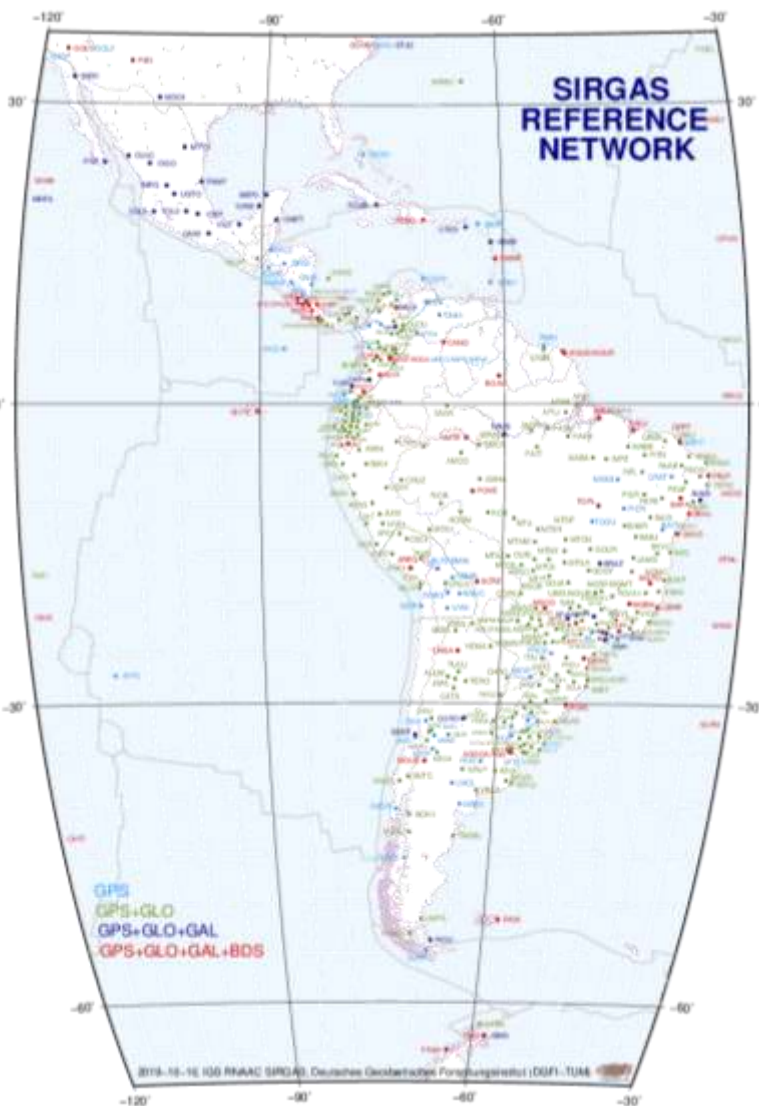
- 13 National Data Centres**
- 9 Processing Centres**
- 2 Combination Centres**
- 2 Atmospheric Analysis Centres**

		DGFI-TUM (Deutsches Geodätisches Forschungsinstitut – TUM) → desde <u>junio-1996</u> en condición de IGS RNAAC SIR
		IBGE (Instituto Brasileiro de Geografia e Estatística) → desde <u>agosto-2008</u>
		IGAC (Instituto Geográfico Agustín Codazzi) → desde <u>agosto-2008</u>
		SGM (Servicio Geográfico Militar) → desde <u>enero-2010</u>
		IGM (Instituto Geográfico Militar) → desde <u>enero-2010</u>
		IGN (Instituto Geográfico Nacional) → desde <u>enero-2011</u>
		INEGI (Instituto Nacional de Estadística y Geografía) → desde <u>enero-2011</u>
		IGM (Instituto Geográfico Militar) → desde <u>enero-2013</u>
		USACH (Universidad de Santiago de Chile) → desde <u>septiembre-2019</u>

4. The SIRGAS-Continuously Operating Network: SIRGAS-CON

SIRGAS-CON

(SIRGAS-Continuously Operating Network)



- It is composed by 411 GNSS stations.
- Its data is given by gubernamental, academics and research entities.
- It is processed every week by the SIRGAS Analysis Centres:
 - Core (continental array) by the IGS-RNAAC-SIR¹, i.e. DGFI-TUM²
 - National densifications by the Local Centres
- Two Combination Centres offer solutions aligned to the ITRF → IBGE y DGFI-TUM
- **Products:**
 - **loosely constrained solutions**
 - **adjusted solutions**
 - **multi-year solutions**

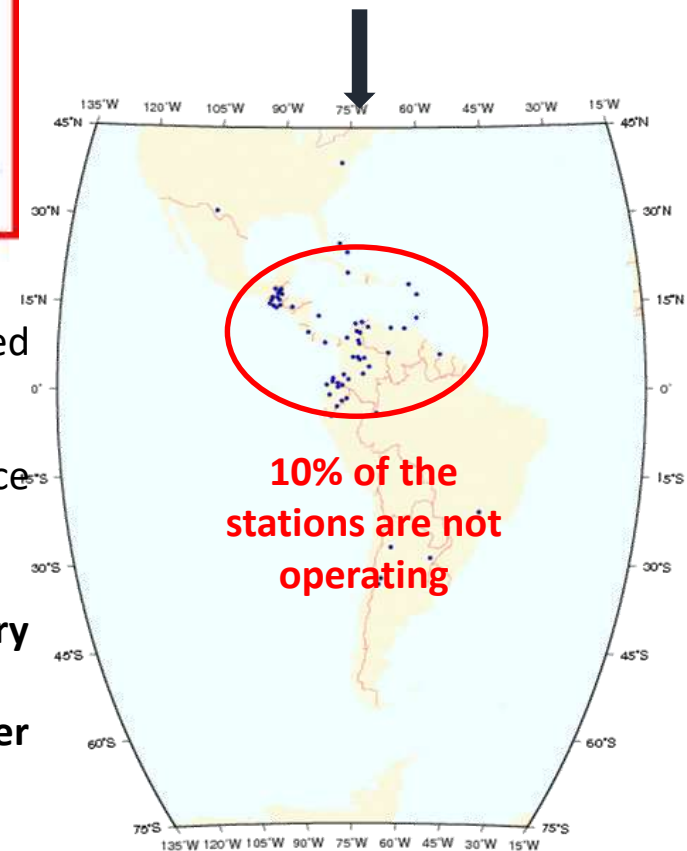
4. The SIRGAS-Continuously Operating Network: SIRGAS-CON

- The network growing has been stable during 2015-2019 period.

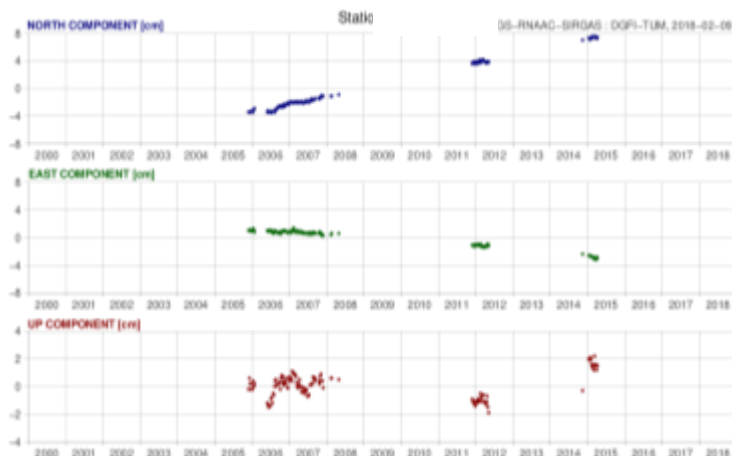
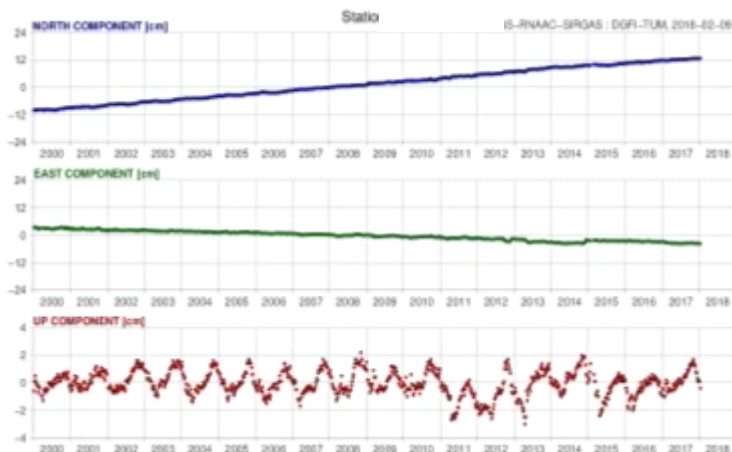


- Each stations in included in every individual solution generated by the Processing Centres.
- Three recent changes in the stations distributions took place because of:
 - Stop processing operation at (Costa Rica), december 2018
 - Stop processing operation at LUZ (Venezuela), february 2019
 - Becoming of USC (Chile) as processing centre, september 2019

the network solutions include only a 90% of the SIRGAS-CON stations



about the continuous operation



- Are the station really being used?
- How many stations do we really need?
- Do we really have the technical and logistics capacities for processing more stations?
- Do the stations really fulfill the GGRF conditions?

the new SIRGAS-WGI have to answer to this questions...

4. La red SIRGAS de operación continua: SIRGAS-CON

- However, since 1996 to 2019 (and beyond!):

SIRGAS-CON

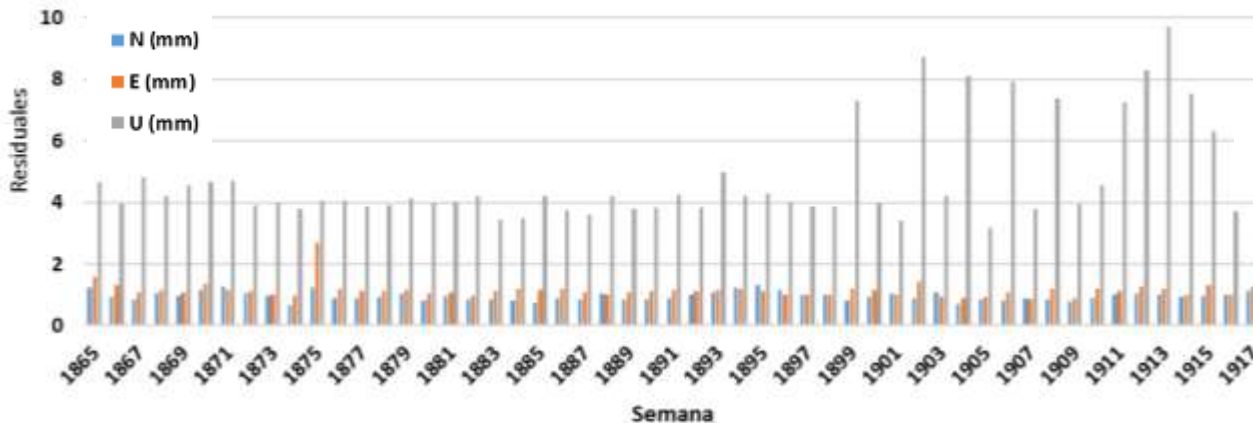
processing on a weekly interval
(strongly necessary in Latin America)

- WGI activities are focus to ensure the network operativity
- only possible thanks to the collaborative working and capacities building
- starting point: the key products of the SIRGAS-CON processing, i.e. weekly and multi-year solutions

- provides an accurate and stable reference frame, accessible at global, regional and local level
- guarantees the compatibility for the acquisition and treatment of geospatial information
- contributes with an effective implementation of the GGRF in Latin America
- defines a observational base for studying Earth System phenomena

SIRGAS-CON
has a long-term stability and
homogeneous consistency

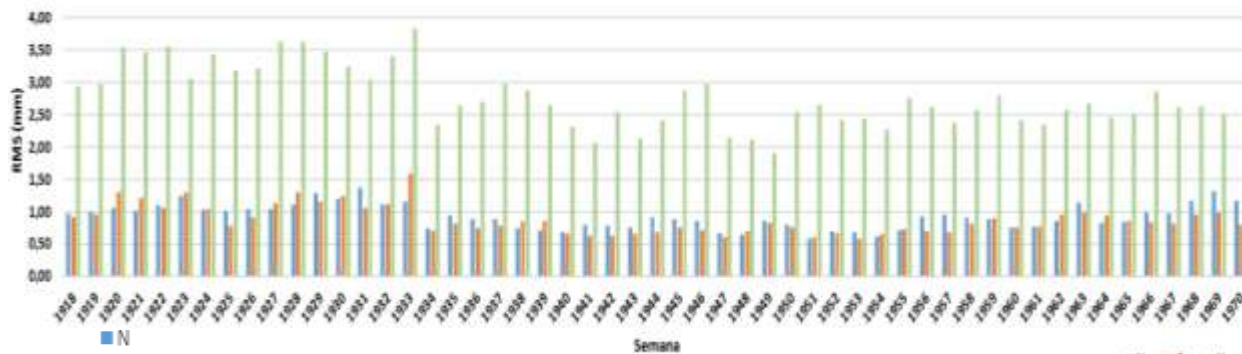
SIRGAS-CON general accuracy: 2015 to 2018



2015-2016

N,E = ± 1.05 mm

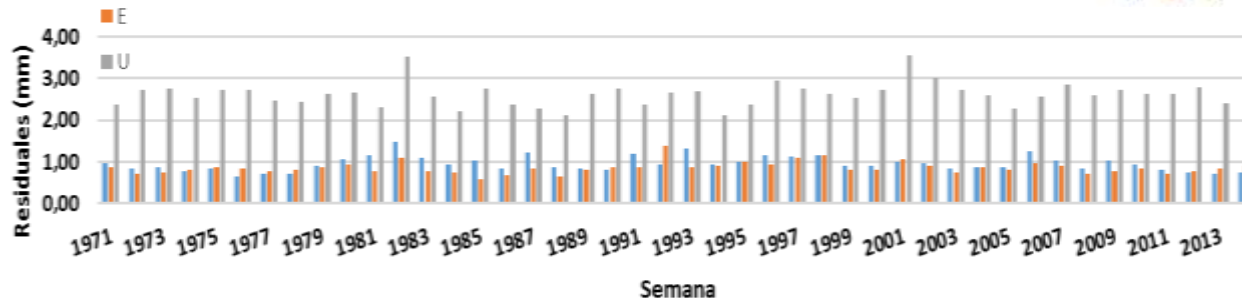
U = ± 4.75 mm



2016-2017

N,E = ± 0.91 mm

U = ± 2.77 mm



2017-2018

N,E = ± 0.91 mm

U = ± 2.62 mm

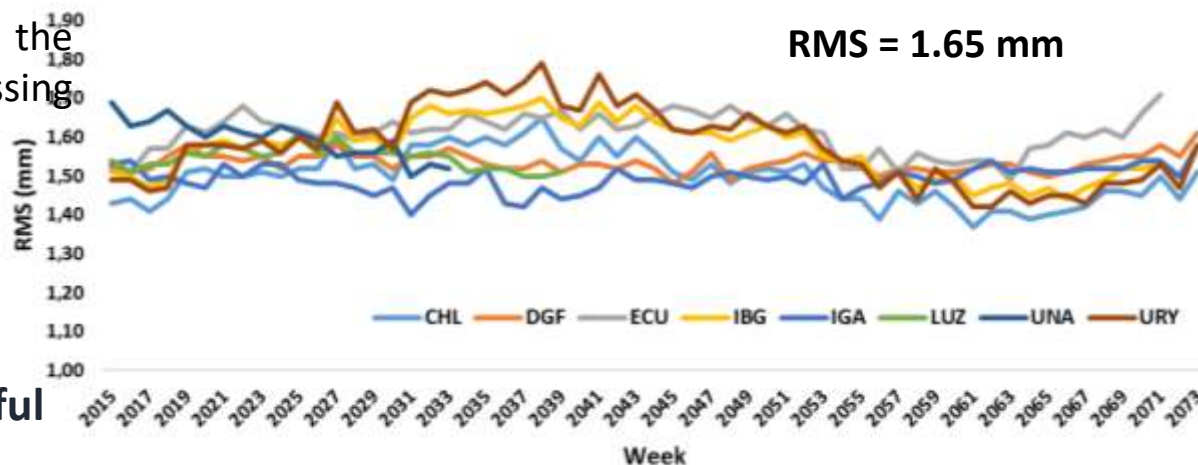
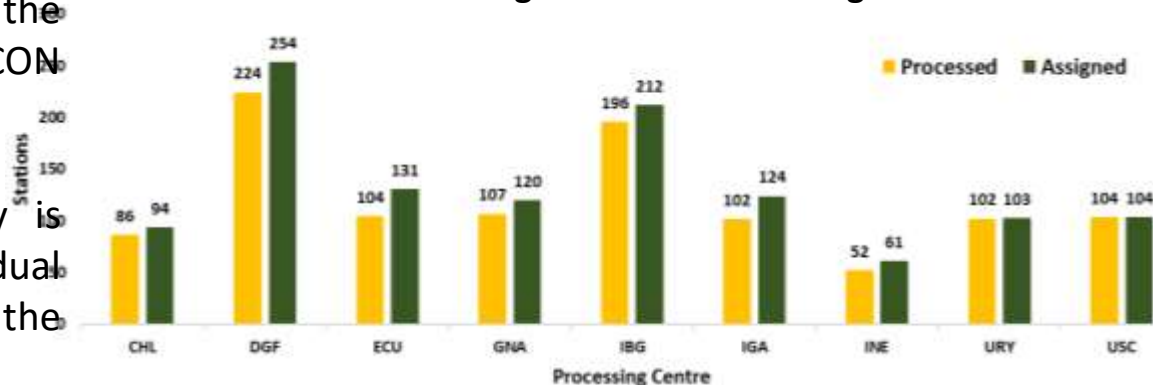
SIRGAS-CON general accuracy 2018 to 2019

- The individual solutions agree with the quality criteria for the SIRGAS-CON processing.
- Internal and external consistency is evaluated for every individual contribution, and the same for the combined solution.
- For obtaining accurate solutions, the optimal performance of the Processing Centres is fundamental

↓

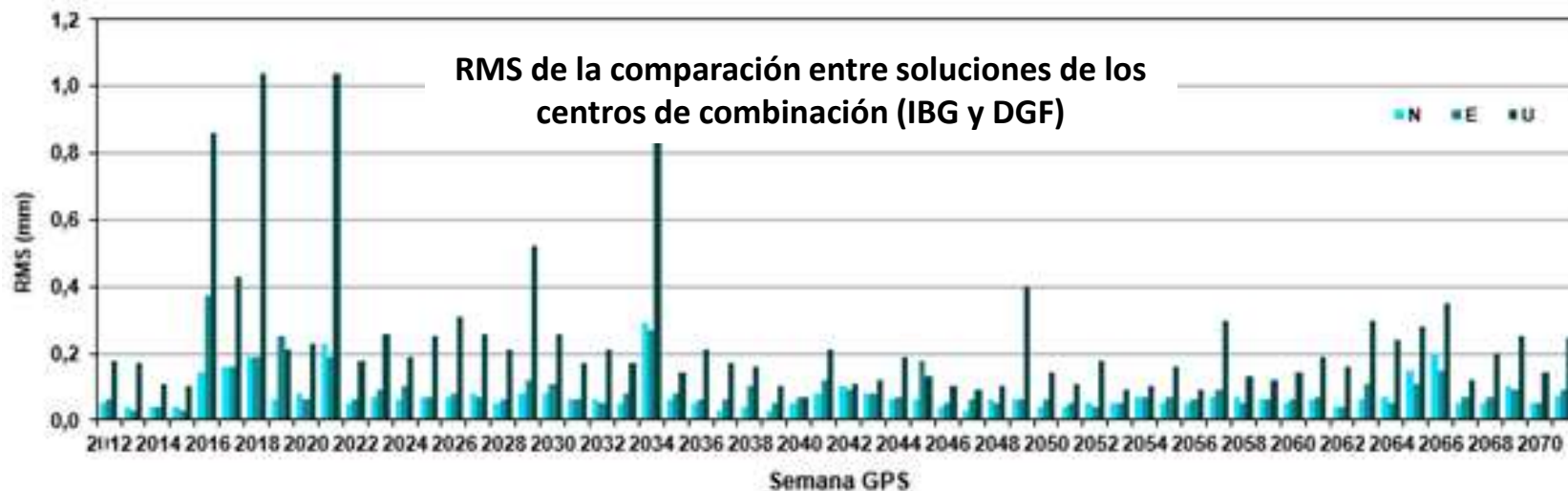
**the Processing Centres
performance has been successful**

Stations assigned to the Processing Centres



5. SIRGAS-CON stability and consistency: 2015 to 2019

- Both Combination Centres offer similar results after the SIRGAS-CON processing and adjustment → a quality control is done for every step of the estimation process



IBG SOLUTION ALIGNED TO IGS14 - FINAL COMBINATION - WEEK 2069				

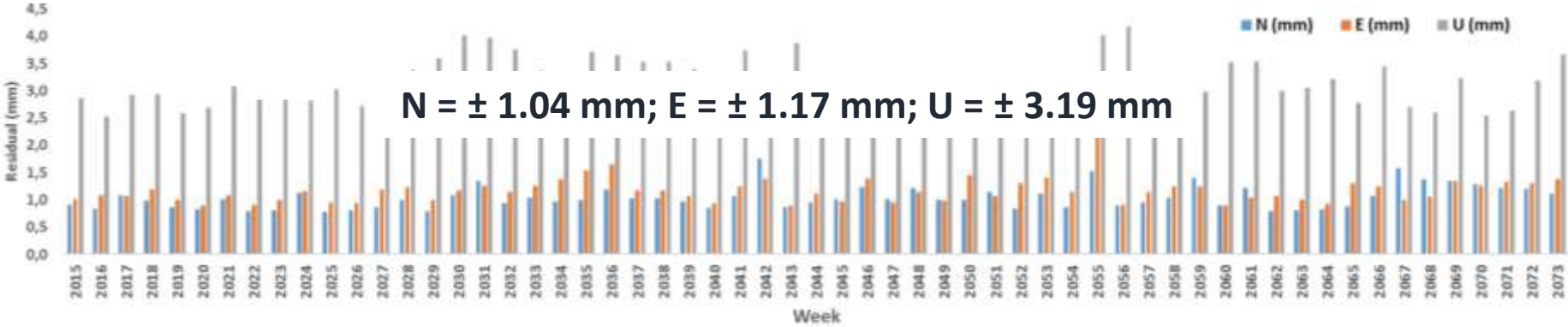
LOCAL GEODETIC DATUM: IGS14		EPOCH: 2019-09-04 12:00:00		
NUM	STATION NAME	X (M)	Y (M)	Z (M)
1	AACR 40612M001	644009.05024	-6251064.25138	1093780.94785
3	ABCC 41939M001	1739437.99007	-6117252.44125	515065.10141
4	ABMF 97103M001	2919785.78497	-5383744.96155	1774604.85531
5	ABPD 41941M001	1742983.24954	-6118331.49223	494730.74841
7	ABPW 41940M001	1753507.20872	-6113239.03668	518210.61627
8	ABRA 41575M001	2423793.39069	-5367435.02845	-2449718.30993
13	AGCA 41907M001	1782547.09320	-6054787.91987	916299.56603
14	AGGO 41596M001	2765120.87452	-4449248.39608	-3626403.69113
19	ALAR 41653M001	5043729.69182	-3753105.62268	-1072966.81365

Week 2069: SIRGAS solution aligned to IGS14 (wrt igs19P2069)				

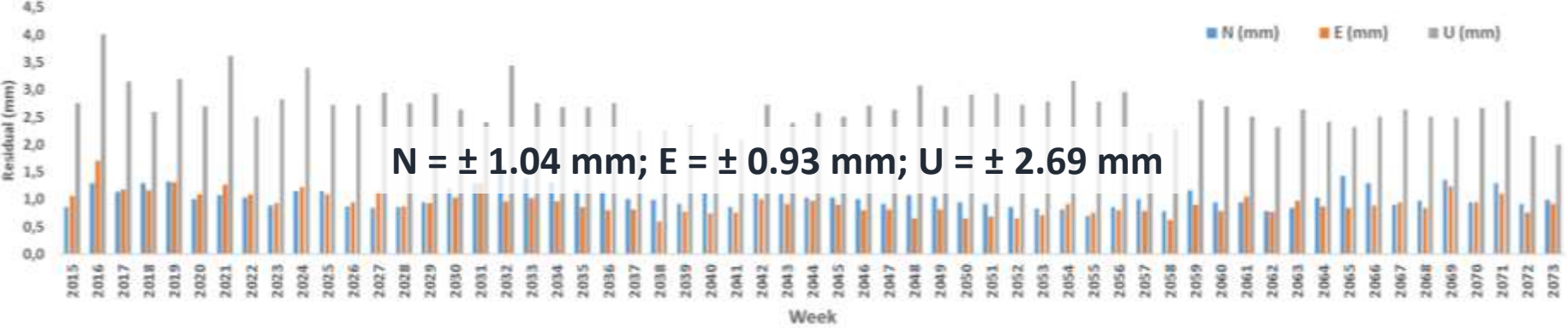
LOCAL GEODETIC DATUM: IGS14		EPOCH: 2019-09-04 12:00:00		
NUM	STATION NAME	X (M)	Y (M)	Z (M)
1	AACR 40612M001	644009.05011	-6251064.25153	1093780.94808
3	ABCC 41939M001	1739437.98995	-6117252.44153	515065.10167
5	ABMF 97103M001	2919785.78484	-5383744.96173	1774604.85555
6	ABPD 41941M001	1742983.24942	-6118331.49253	494730.74867
8	ABPW 41940M001	1753507.20861	-6113239.03699	518210.61653
9	ABRA 41575M001	2423793.39056	-5367435.02867	-2449718.30961
14	AGCA 41907M001	1782547.09309	-6054787.92014	916299.56628
15	AGGO 41596M001	2765120.87437	-4449248.39630	-3626403.69080
21	ALAR 41653M001	5043729.69167	-3753105.62306	-1072966.81336

5. SIRGAS-CON stability and consistency: 2015 to 2019

Residuals with respect to the SIRGAS-CON weekly solution:



Residuals with respect to the IGS weekly solution:



accuracy of the determinations → ± 0.91 mm
± 2.94 mm

SIRGAS-CON keeps its accuracy!

- The training activities and goals divulgation are very important for the SIRGAS-WGI.
- Two courses were taught for the appropriate management of the Processing Centres:
 - Universidad de Santiago de Chile (2018).
 - Instituto Geográfico Militar de Ecuador (2019).
- Main aspects related to SIRGAS and specially with SIRGAS-CON were demonstrated in proper spaces (papers, meetings, and so).

<http://www.sirgas.org/es/publications>
<http://www.sirgas.org/es/presentations>

SIRGAS: Reference frame in Latin America

SIRGAS is the geocentric reference system for the Americas, by definition it is identical to the ITRF and defines the regional densification of the ITRF in Latin America which NSS network in the continent called SIRGAS-CON

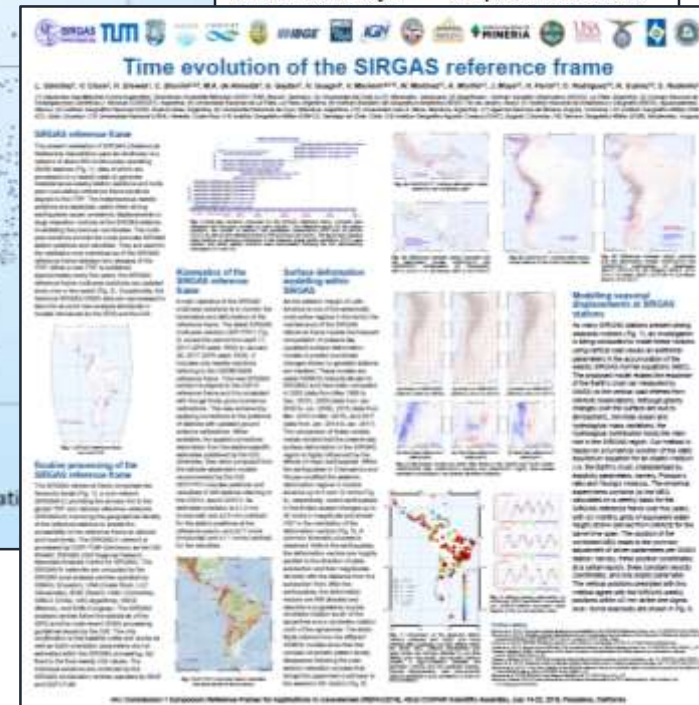


A brief introduction

Since its establishment 25 years ago, SIRGAS (Spanish acronym for Geocentric Reference System for the Americas) is the starting point in Latin America dealing with acquisition and treatment of geospatial information with scientific and technical features for applications beyond geodesy. Scopes and goals of SIRGAS have been showed in previous editions (e.g. Bruzini and Sánchez, 2012; Fortes et al., 2006). Following to Cioco et al. (2018), this time is appropriate to share an overview about its evolution, consolidation and current role as an organization responsible for the maintenance of the continental geodetic

held in Asunción, Paraguay, organized by the IAG (International Association of Geodesy), PAIGH (Pan-American Institute for Geography and History) and NIMA (US National Imagery and Mapping Agency, now NGA, National Geospatial-Intelligence Agency).

In 2000, the UN (United Nations) recognized its achievements and SIRGAS became the reference system recommended for all countries in the Americas. This still is a valid fact taking in consideration the Resolution A/RES/59/266 approved in 2015 concerning to the GGRF (Global Geodetic Reference Frame) for Sustainable Development, because SIRGAS is the



Closing remarks (some reflections)...

- The current role of the geodesy for Latin America (and the World) demands and highly accurate reference frame, SIRGAS is who provides the ITRF densification in this region.
- SIRGAS-CON not only represent such densification, also it supports a wide variety of applications in geosciences.
- The Working Group I (Reference System) ensures that SIRGAS-CON holds its quality standard, i.e. ± 1 mm in horizontal position and ± 3 mm in vertical.
- The collaboration and group working are key elements for the maintenance of the continental reference frame → thanks and congratulations to all institutions and human resources involved for keep going in SIRGAS.
- Two open questions: – **What is there left to do?**
– **Where must go the SIRGAS-WGI?**



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...muito obrigado!*

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