

# Recent IBGE Activities and Results as SIRGAS Analysis Center

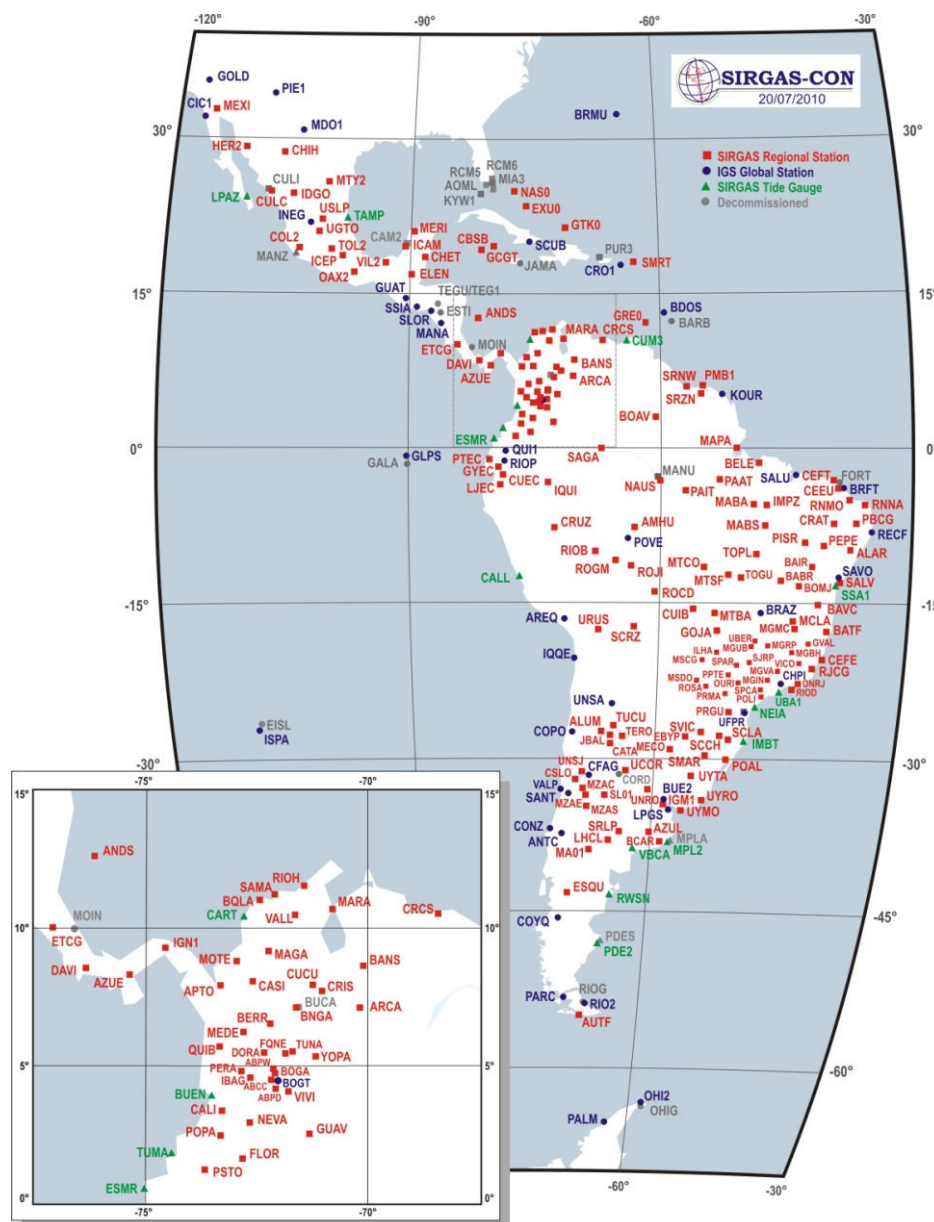
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Alberto Luis da Silva  
Jhannes Alberto Vaz  
Newton José de Moura Junior

AGU2010,  
Iguassu Falls, 8-12 august 2010

## Overview

- ✓ SIRGAS-CON Network
- ✓ Motivation
- ✓ SIRGAS Analysis Centre - IBGE
- ✓ Processing Strategies
- ✓ Results
- ✓ RMS of Residuals
- ✓ Station 's Velocities
- ✓ Annual Variation of Up Comp in Amazon Region
- ✓ Displacements due to the Conception Earthquake
- ✓ Analysis Centre Website

# SIRGAS-CON NETWORK

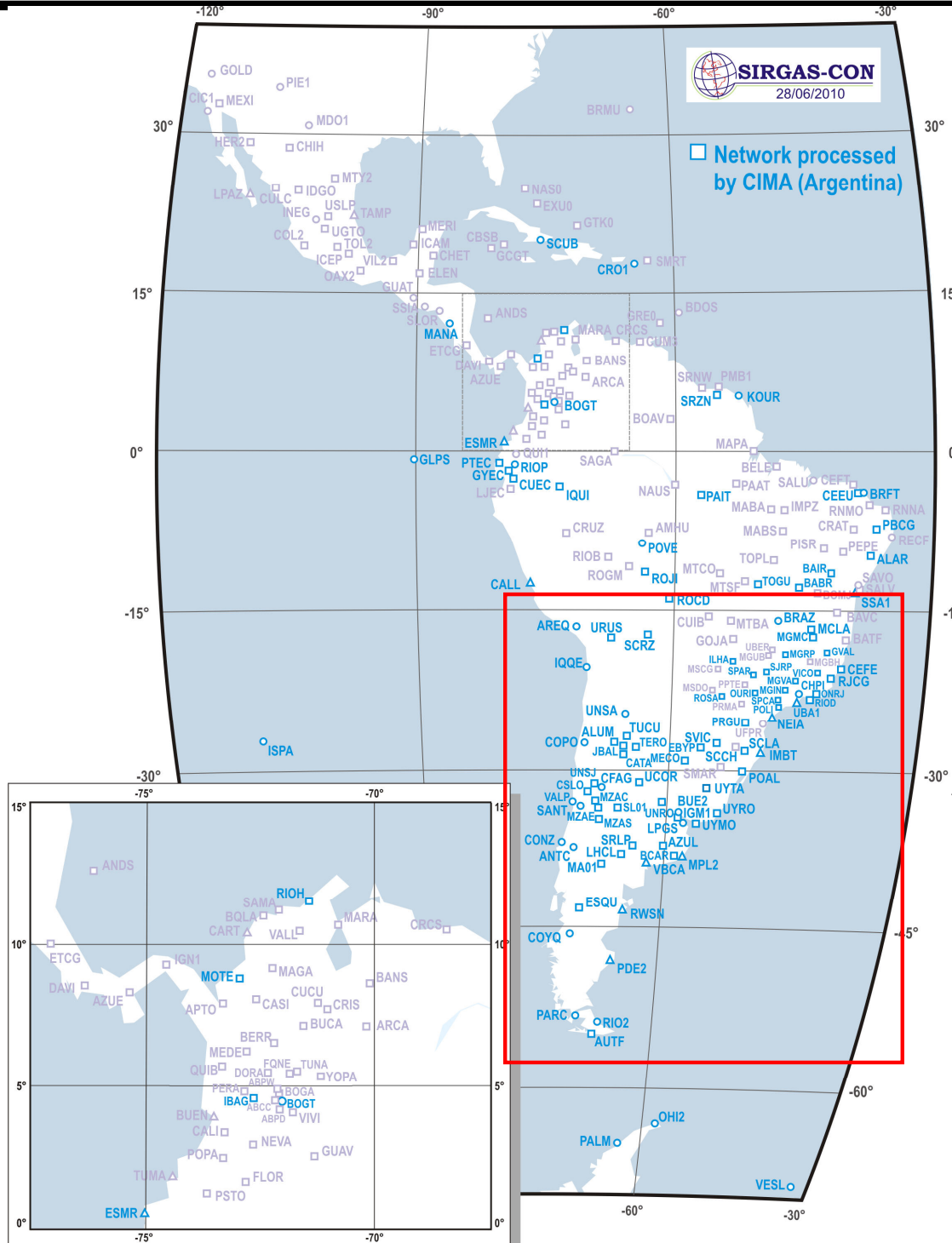


[www.sirgas.org](http://www.sirgas.org)

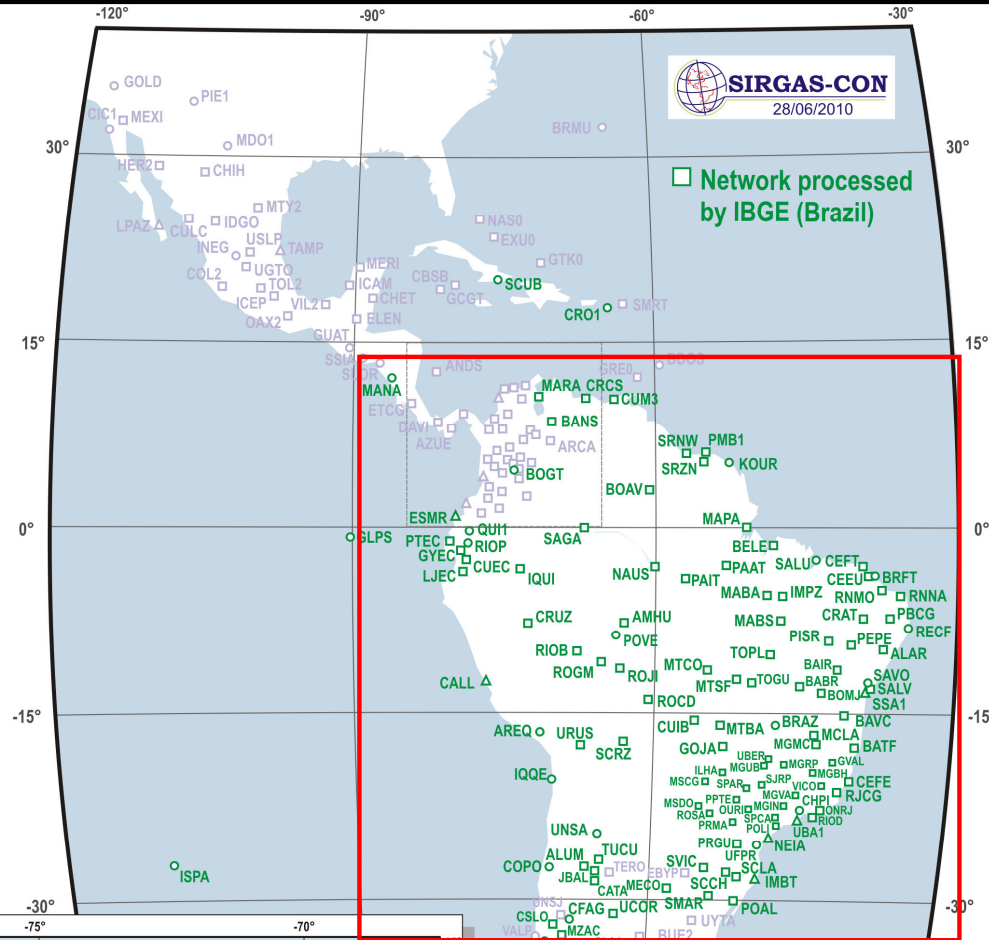
- ✓ SIRGAS-CON network is regional densification of the ITRF in South and Central Americas and Caribbean Region ,
- ✓ A network of continuously operating GNSS stations with high precision coordinates (associated to a specific reference epoch) and their changes over time (station velocities),
- ✓ Composed of more than 190 stations, (more than 50 are part of the global IGS network).

## Local Analysis Centres

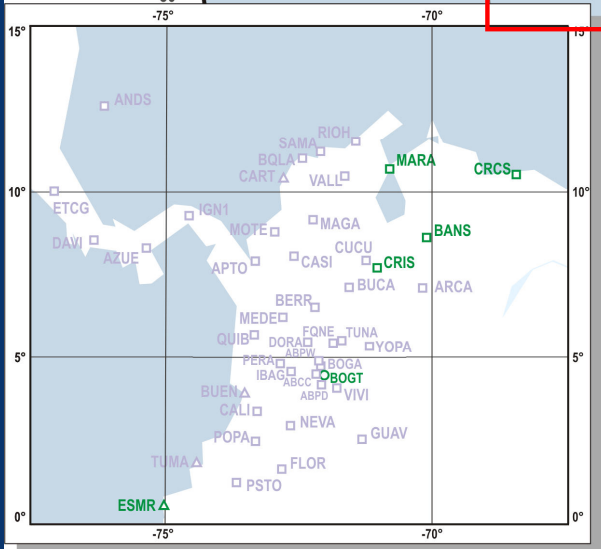
- ✓ Centro de Procesamiento Ingeniería-Mendoza-Argentina de la Universidad Nacional de Cuyo, CIMA (Argentina)
- ✓ Instituto Brasileiro de Geografia e Estatística, IBGE (Brasil)
- ✓ Instituto Geográfico Agustín Codazzi, IGAC (Colombia)
- ✓ Instituto Geográfico Militar de Ecuador, IGM-Ec
- ✓ Servicio Geográfico Militar del Uruguay, SGM-Uy
- ✓ Laboratorio de Geodesia Física y Satelital, Universidad del Zulia, LGFS-LUZ (Venezuela)

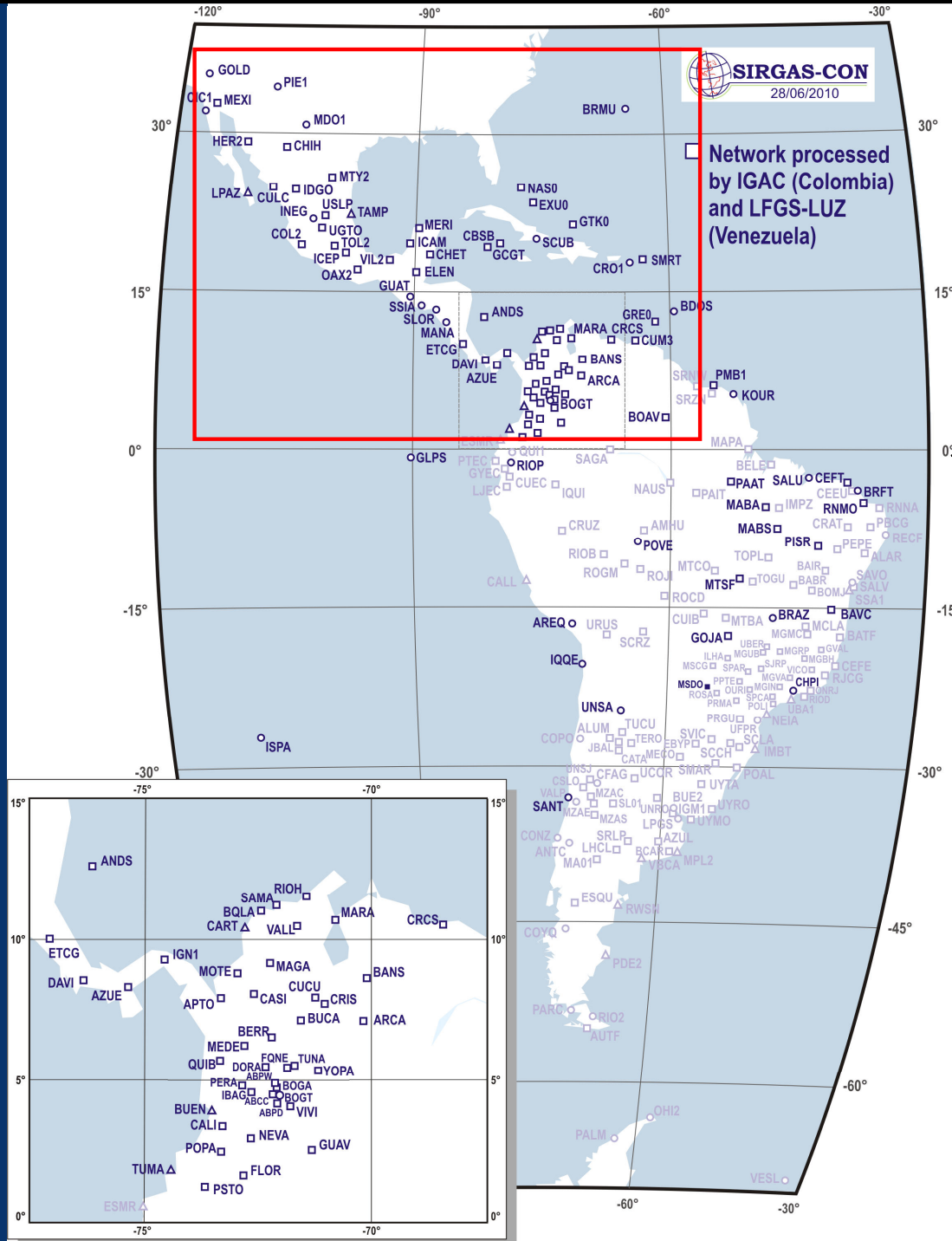


**Centro de  
Procesamiento  
Ingeniería-  
Mendoza-Argentina  
de la Universidad  
Nacional de Cuyo,  
CIMA (Argentina)**



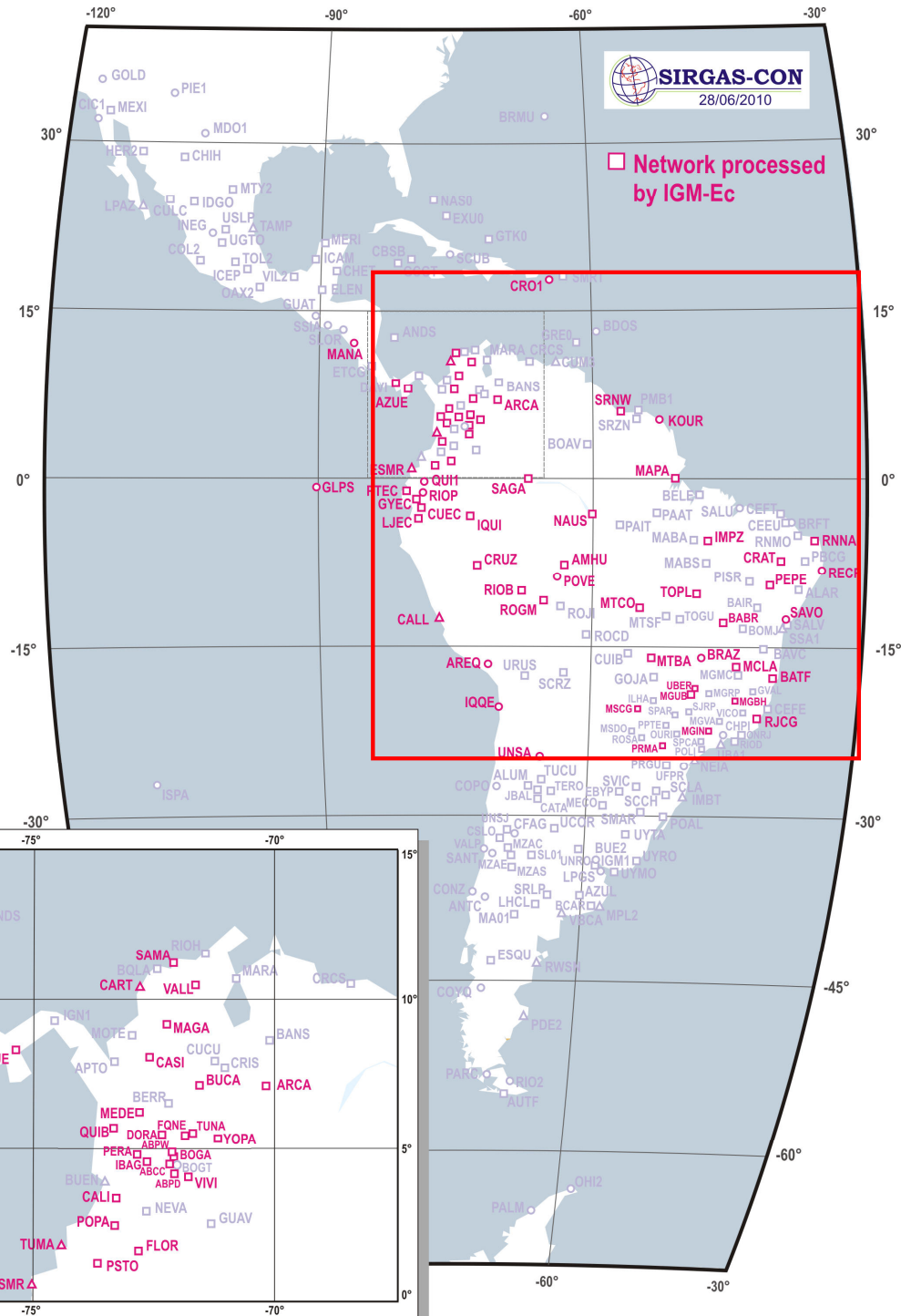
**Instituto Brasileiro de Geografia e Estatística, IBGE (Brasil)**





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**Instituto Geográfico  
Militar de Ecuador,  
IGM-Ec**





**Servicio Geográfico Militar del Uruguay, SGM-Uy**

## Motivation

- ✓ IBGE responsibility:
  - (1) definition and maintenance of the Brazilian Geodetic System – SGB,
  - (2) Operation of GNSS permanent network –RBMC,
  - (3) Maintenance and control of RBMC as the main geodetic reference frame in Brazil
  - (4) Monitoring the temporal variation of the coordinates together with the data quality;

## SIRGAS Analysis Centre– IBGE

- ✓ Data processing since January 2003 (GPS week 1199);
- ✓ Currently around 130 stations are processed;
- ✓ Software: Bernese GPS Software 5.0 – BPE;
- ✓ Results: Daily and weekly (combined) solutions in SINEX format  
(IBGwww7.SNX)
- ✓ New activities:
  - ✓ The Implementation of new ambiguity resolution strategy
  - ✓ Network Combination with software CatRef (IGN)

# Processing Strategy

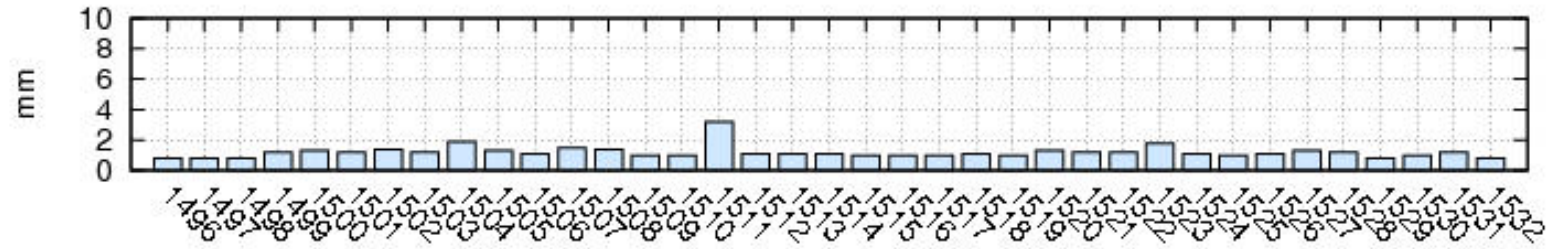
Processing Date	Week 1199 to 1400	After week 1400
Observations	Double Difference	Double Difference
Software used	Bernese 5.0 ( BPE mode)	Bernese 5.0 ( BPE mode)
Sampling rate	30 sec	30 sec
Elevation angle	10°	03°
Baseline formation strategy	SHORTEST	SHORTEST
Orbits/EOP	IGS final - ITRF2000/IGb00 EOP week	IGS final - IGS05 EOP week
A priori troposphere model	Niell dry component	Niell dry component
Troposphere	Zenith delay estimated each 2 hours (12 daily corrections p/station) A priori sigmas applied with respect to prediction model Niell(wet component) -first parameter +/- 5 m absolute and +/- 5 cm relative	Zenith delay estimated each 2 hours (12 daily corrections p/station) A priori sigmas applied with respect to prediction model Niell(wet component) -first parameter +/- 5 m absolute and +/- 5 cm relative
Ambiguity	QIF strategy with GIM from CODE	QIF strategy with GIM from CODE
Ocean Loading Model	GOT00.2	FES2004
Phase Center Variation	Absolute (IGS_05) and Relative	Absolute (IGS_05)
Apriori Coord. and Vel.	IGSb00	IGS05_R
Daily solutions	Minimum constraint in stations BRAZ coordinates ( $\sigma = \pm 1\text{mm}$ ) OUTPUT FILES: SINEX Troposphere maps	Constraint in all stations ( $\sigma = \pm 1\text{m}$ ) OUTPUT FILES: SINEX Troposphere maps
Weekly solutions	12 IGS stations are used to constrain weekly solution ( $\sigma = \pm 0.1\text{mm}$ ) OUTPUT FILES: SINEX	All stations constrained ( $\sigma = \pm 1\text{m}$ ) OUTPUT FILES: SINEX

# RMS of weekly solutions residuals – IBGE X DGFI

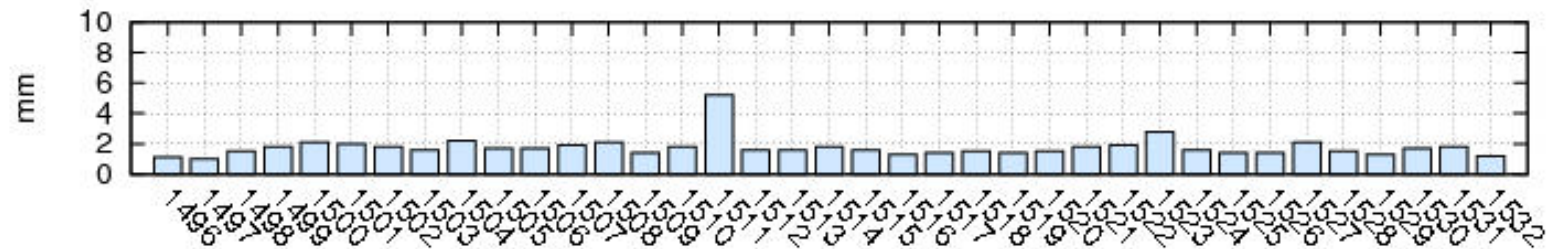


Weekly Root Mean Square → IBGE X DGFI

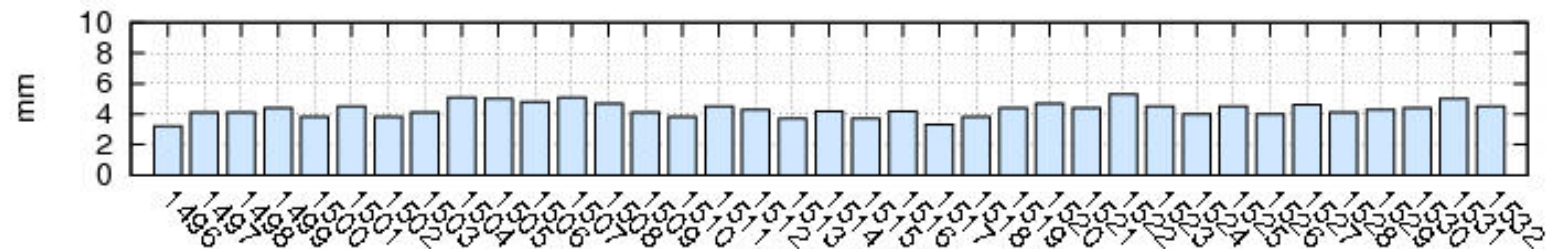
North



East



Up



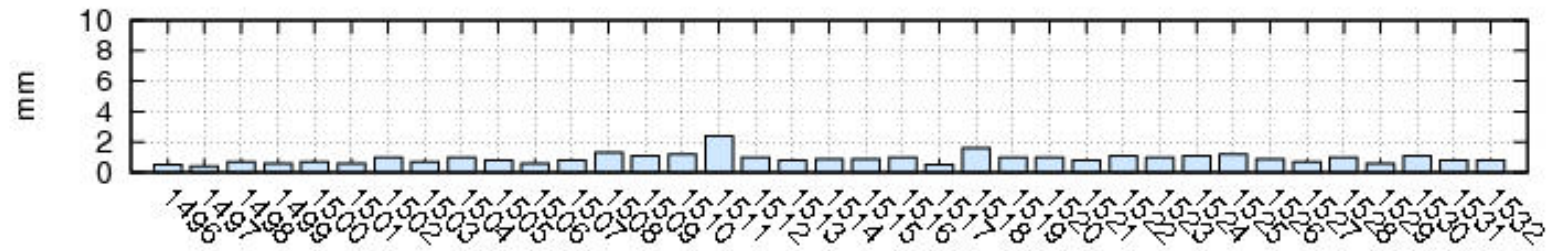
GPS week

# RMS of weekly solutions residuals – IBGE X CIMA

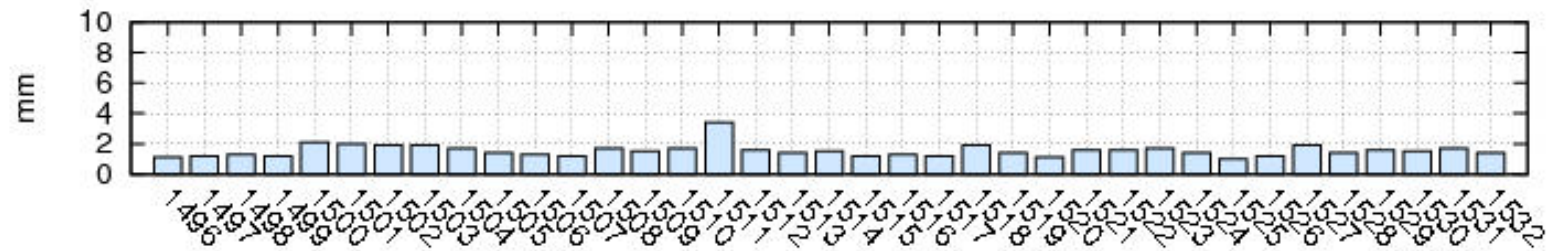


Weekly Root Mean Square → IBGE X CIMA

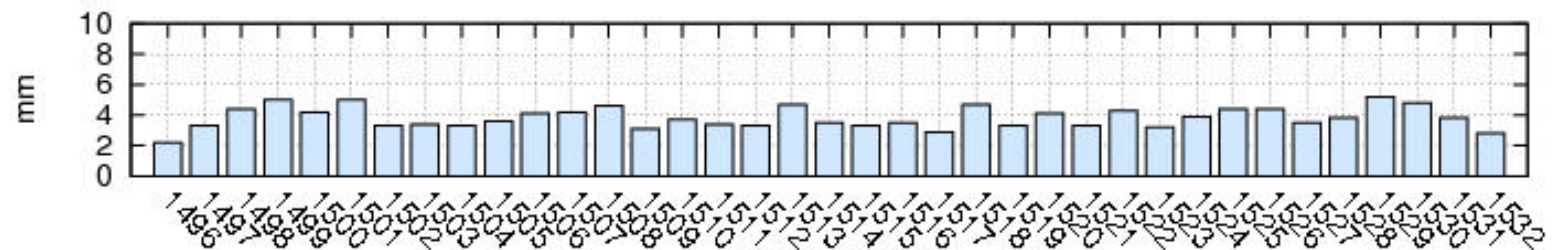
North



East



Up



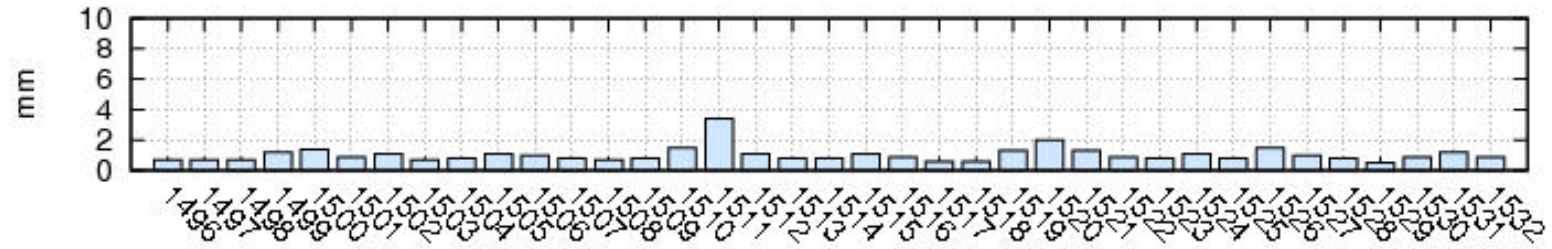
GPS week

# RMS of weekly solutions Residuals – IBGE X IGAC

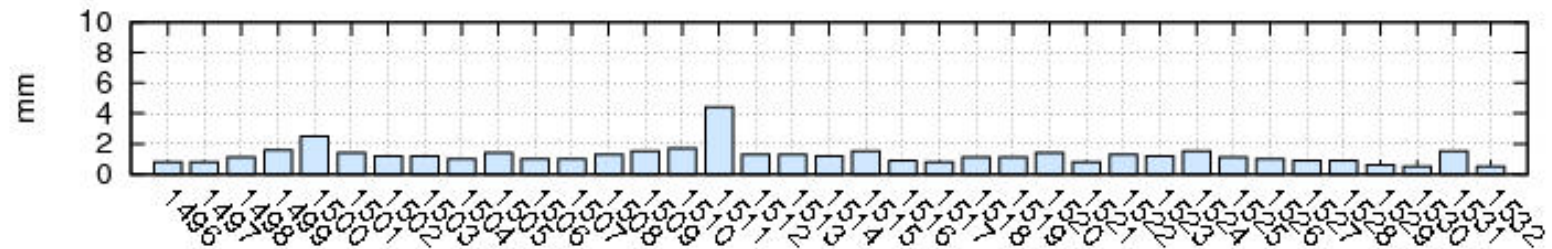


Weekly Root Mean Square → IBGE X IGAC

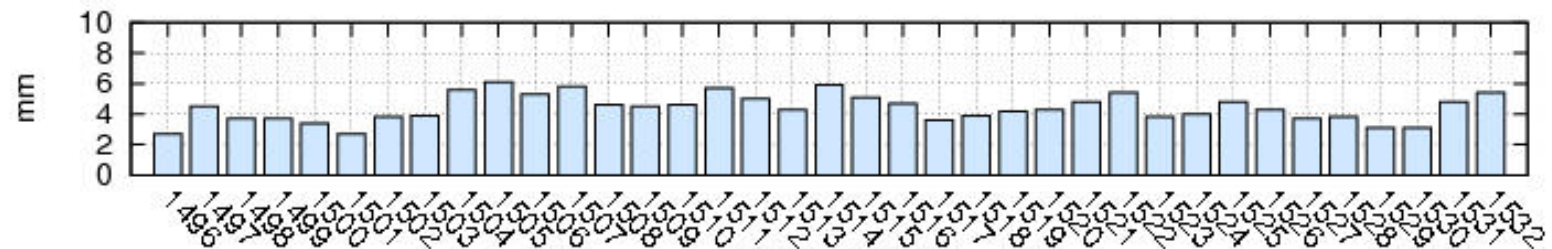
North



East

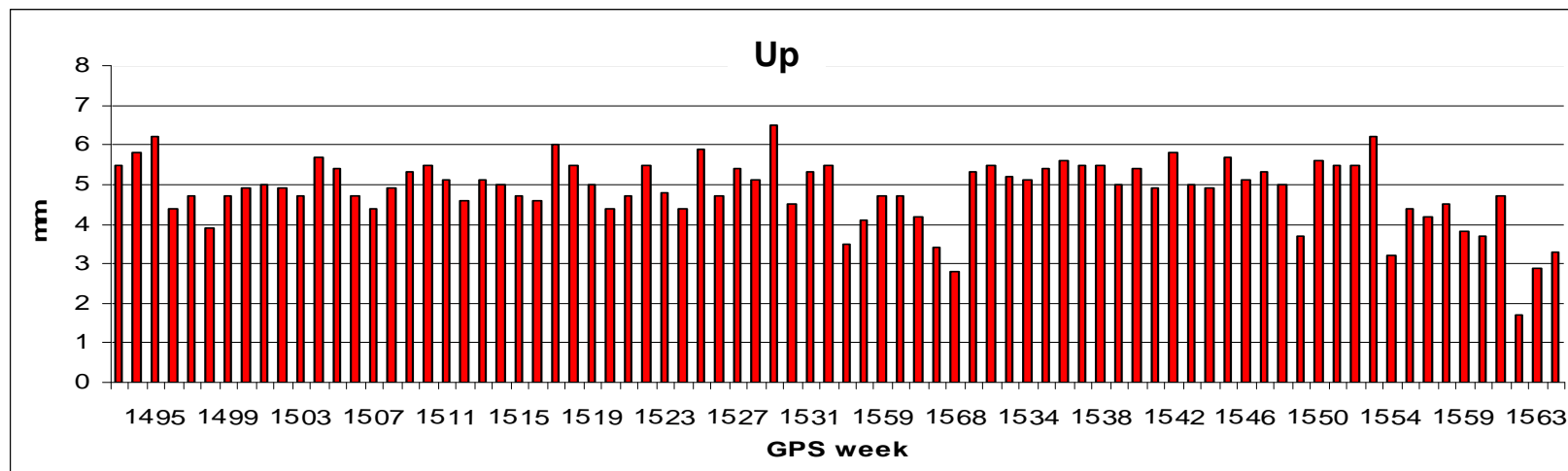
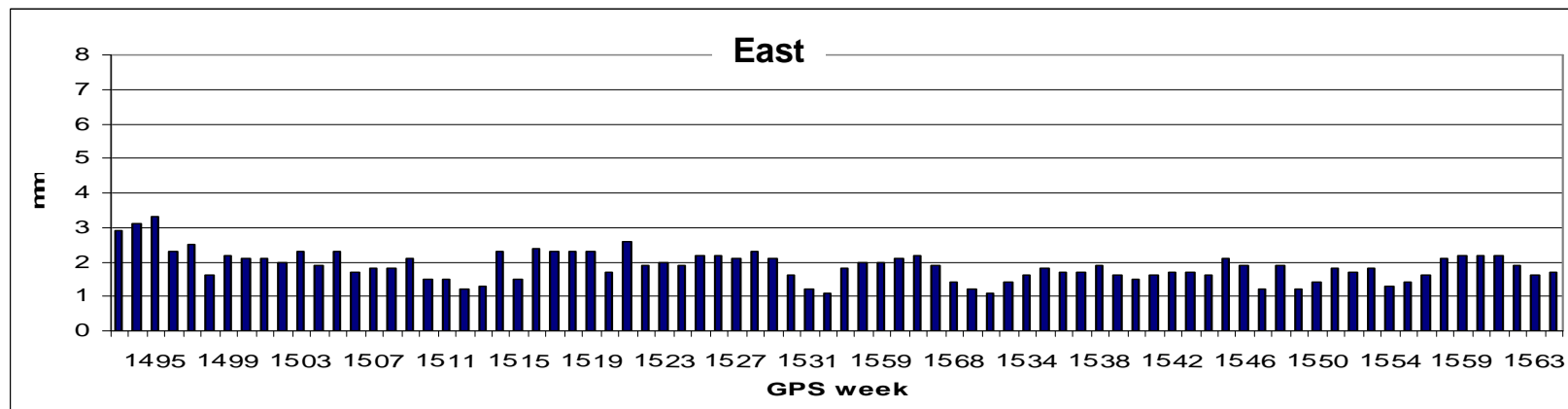
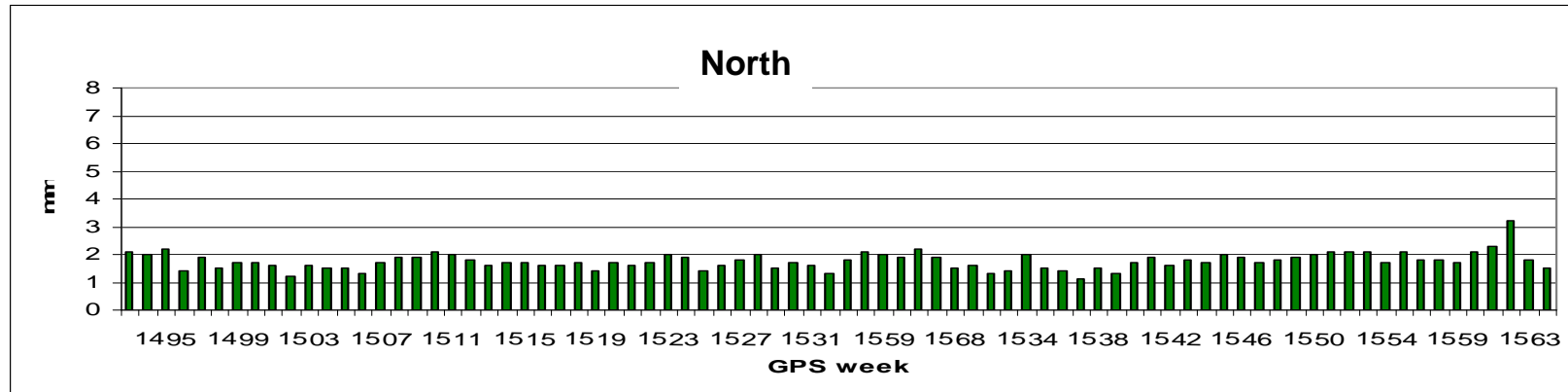


Up



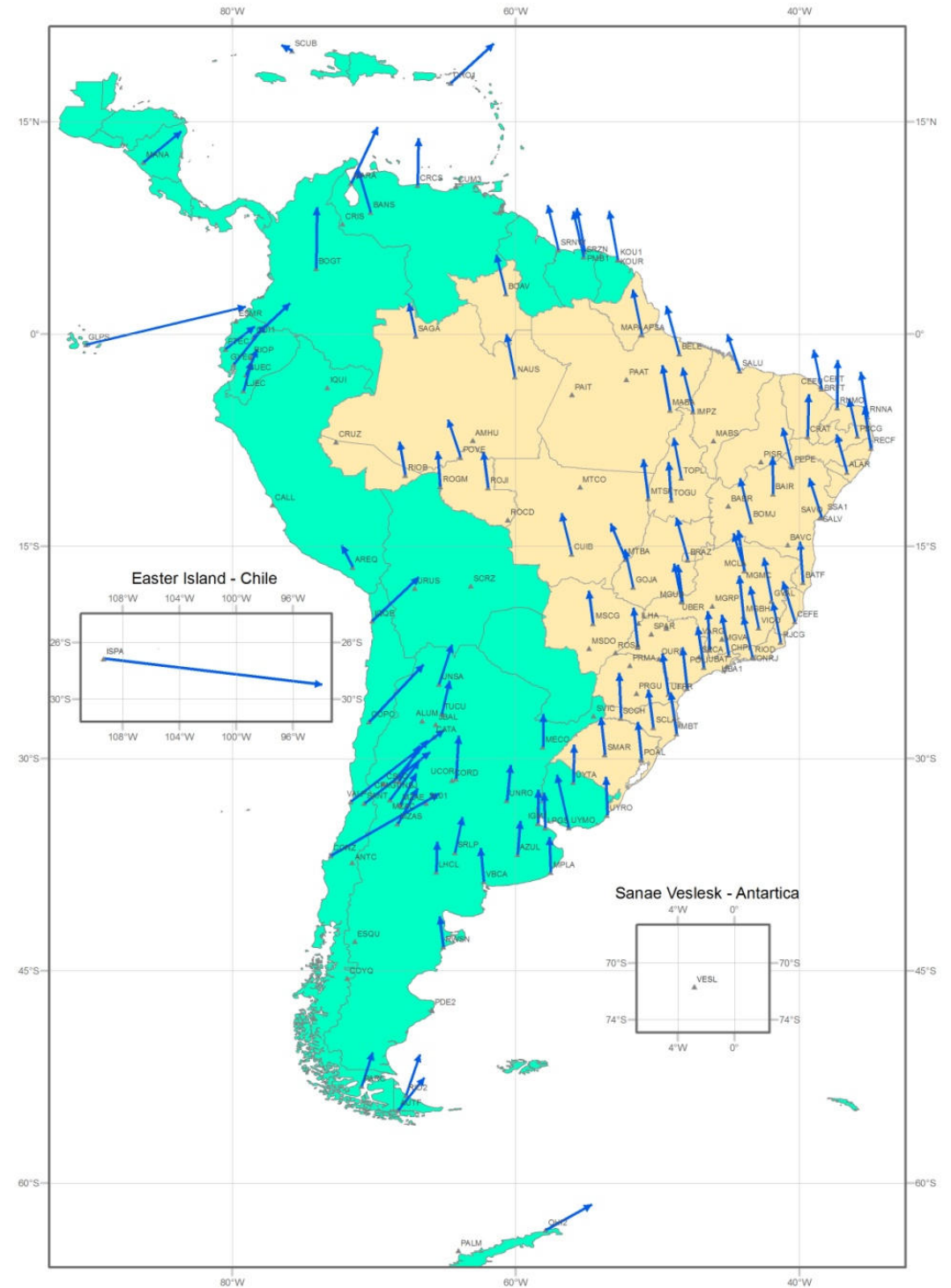
GPS week

# RMS Residuals of weekly solutions – IBGE X IGS05

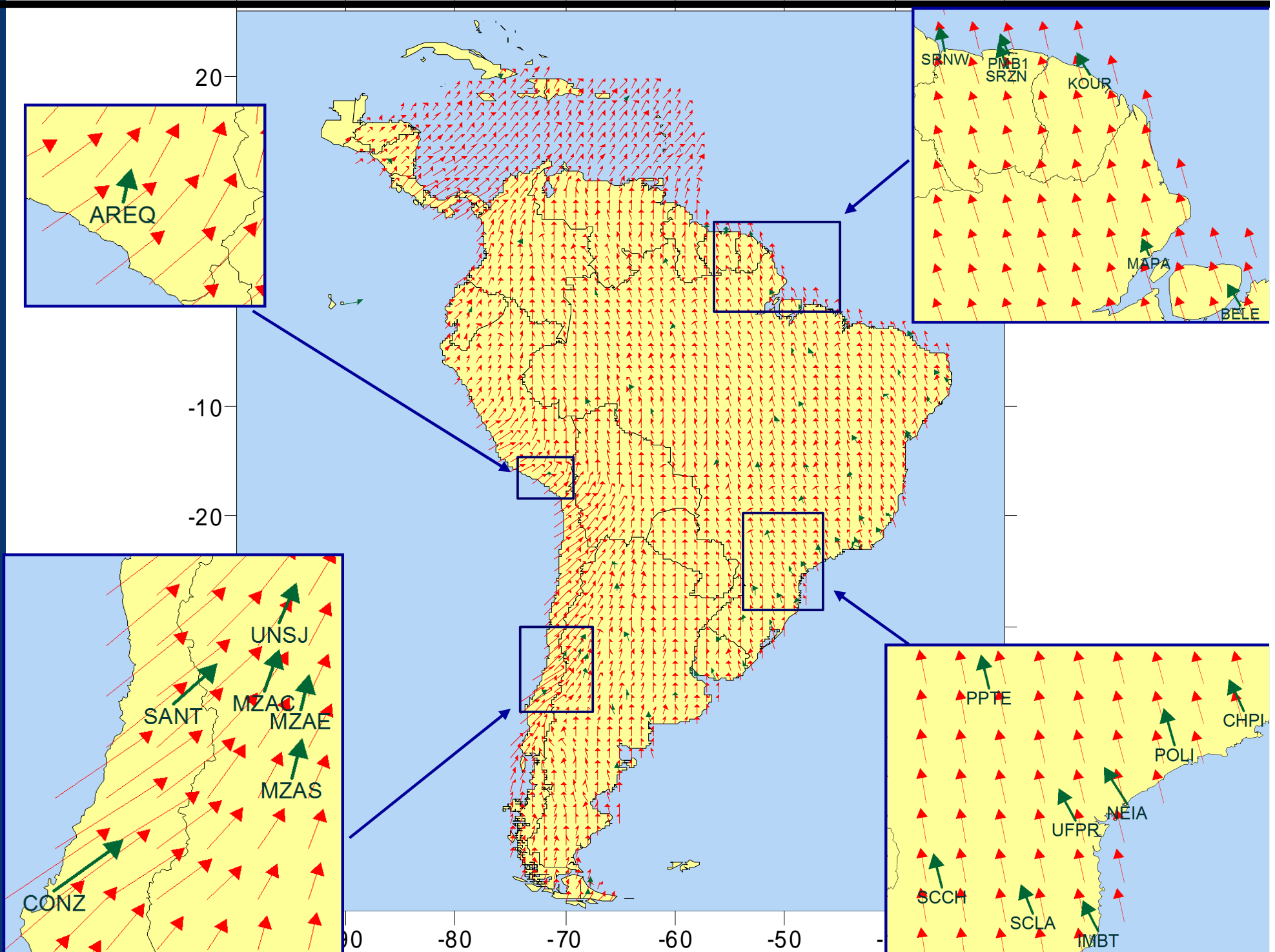




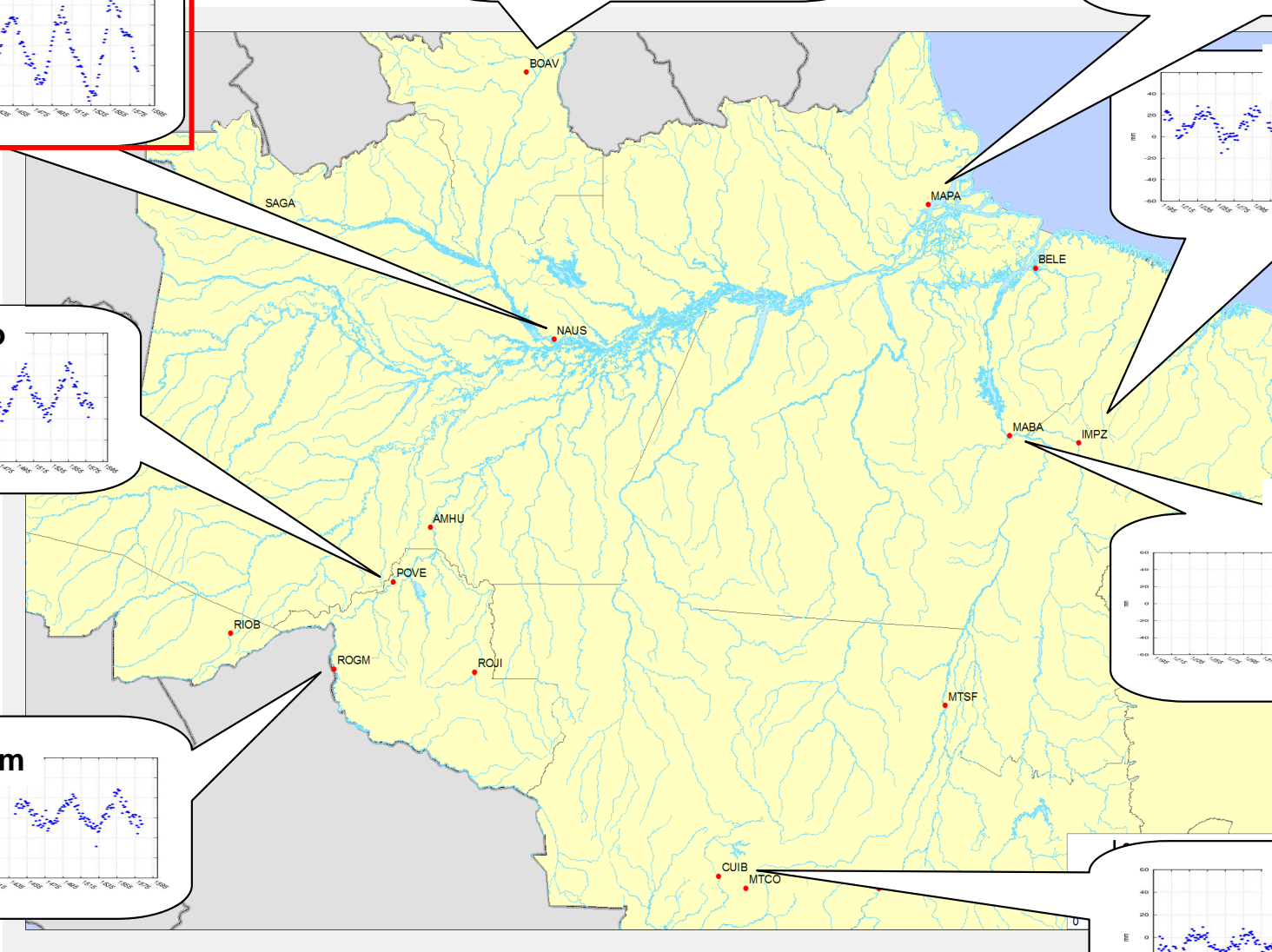
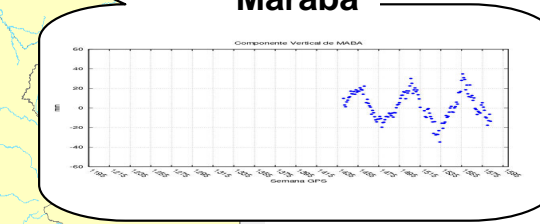
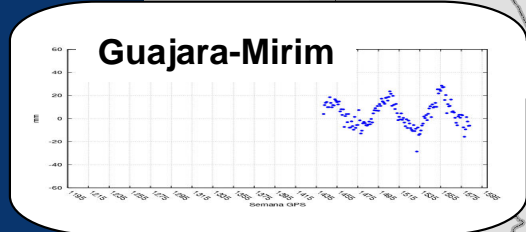
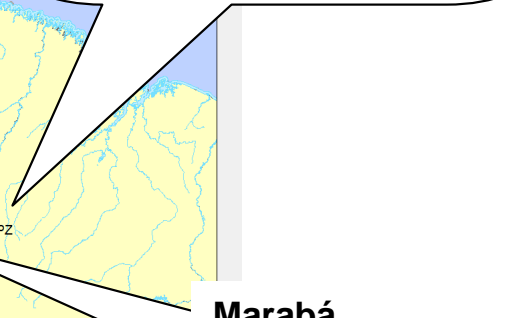
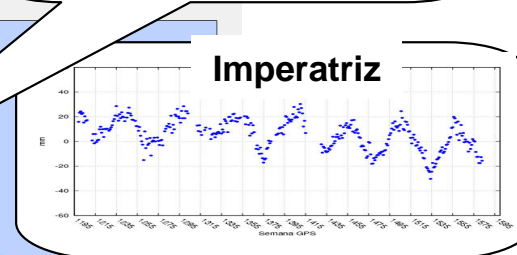
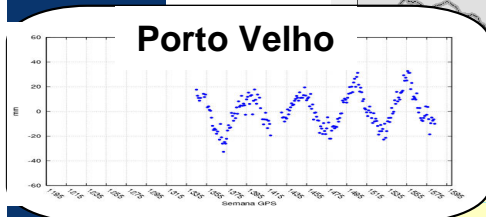
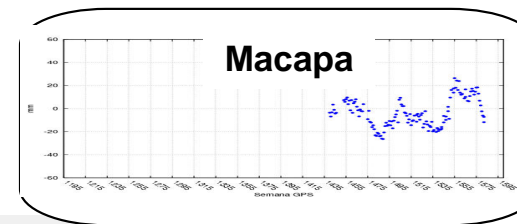
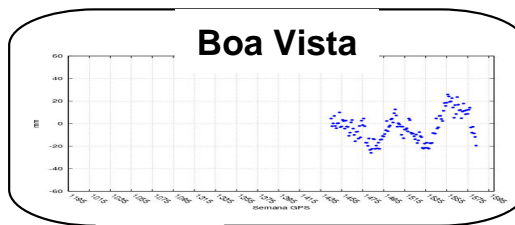
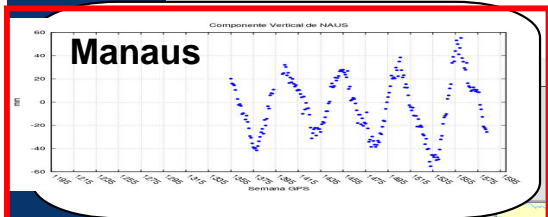
# Stations Velocities



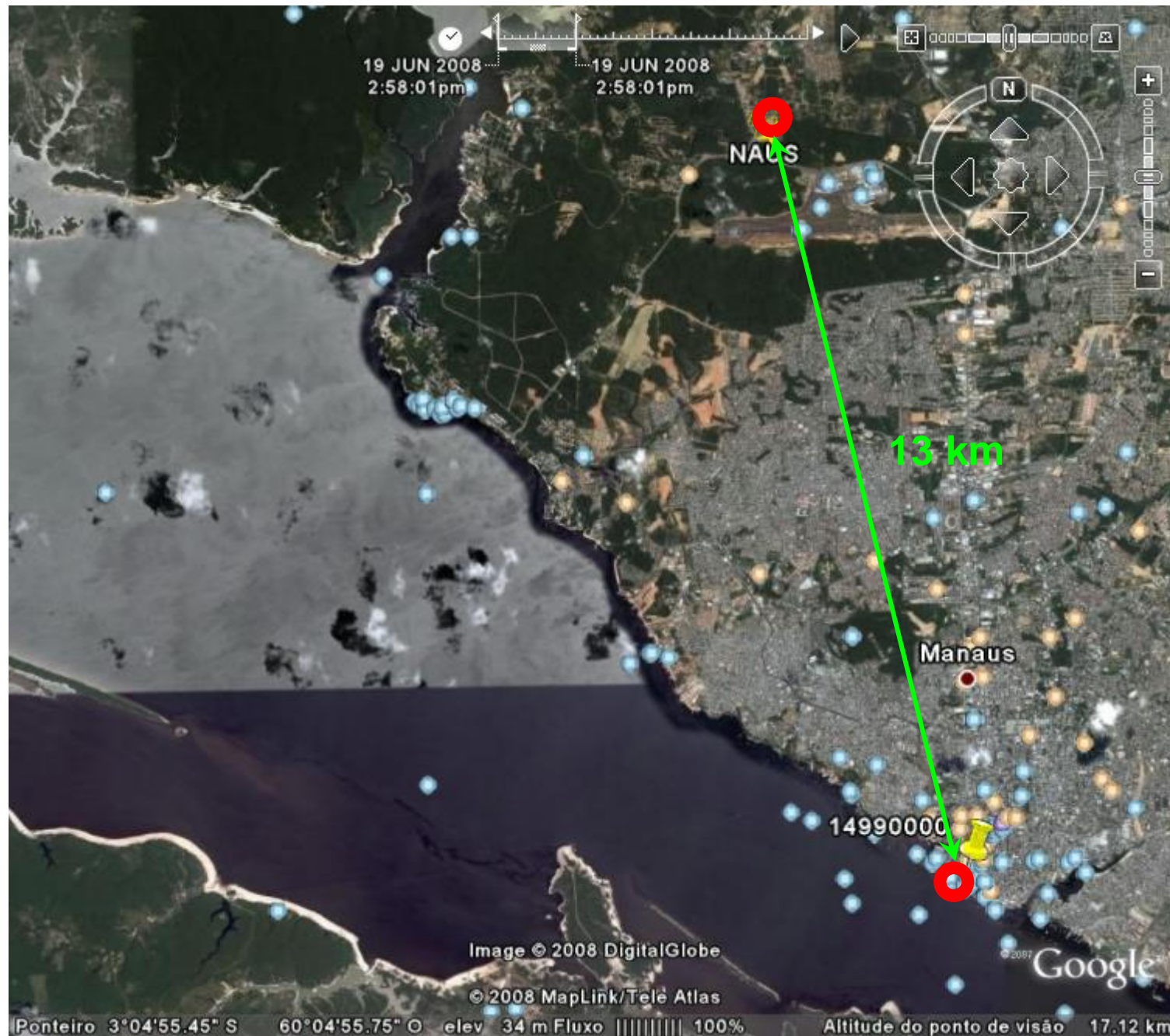
# Estimated Velocities: IBGE X VEMOS2009



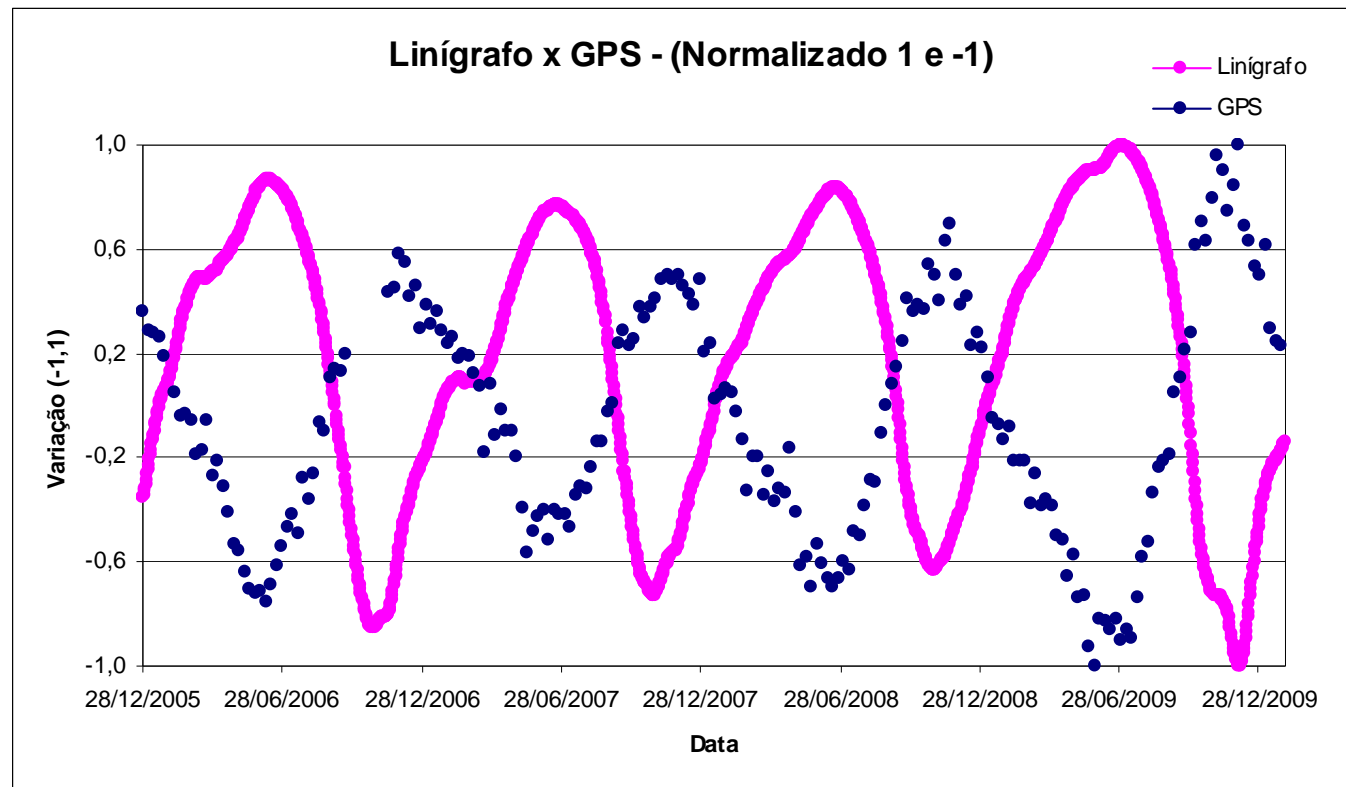
# Anual Variation of Up Component



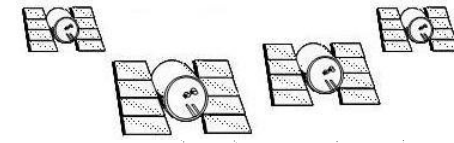
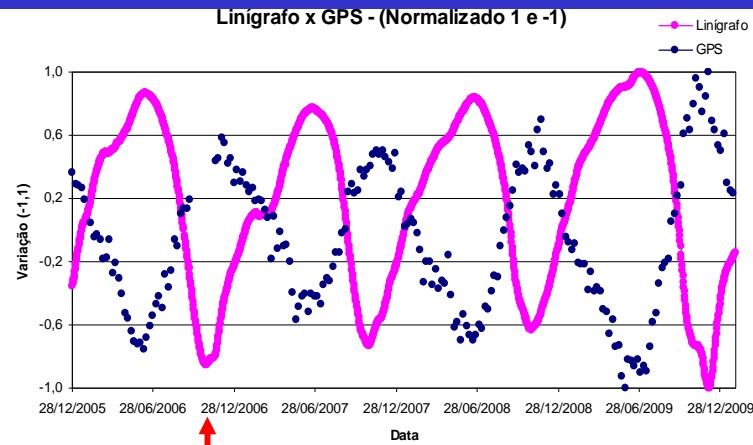
# Distance between two stations (GNSS / linmetric)



# Time Series – station NAUS x linmetric station



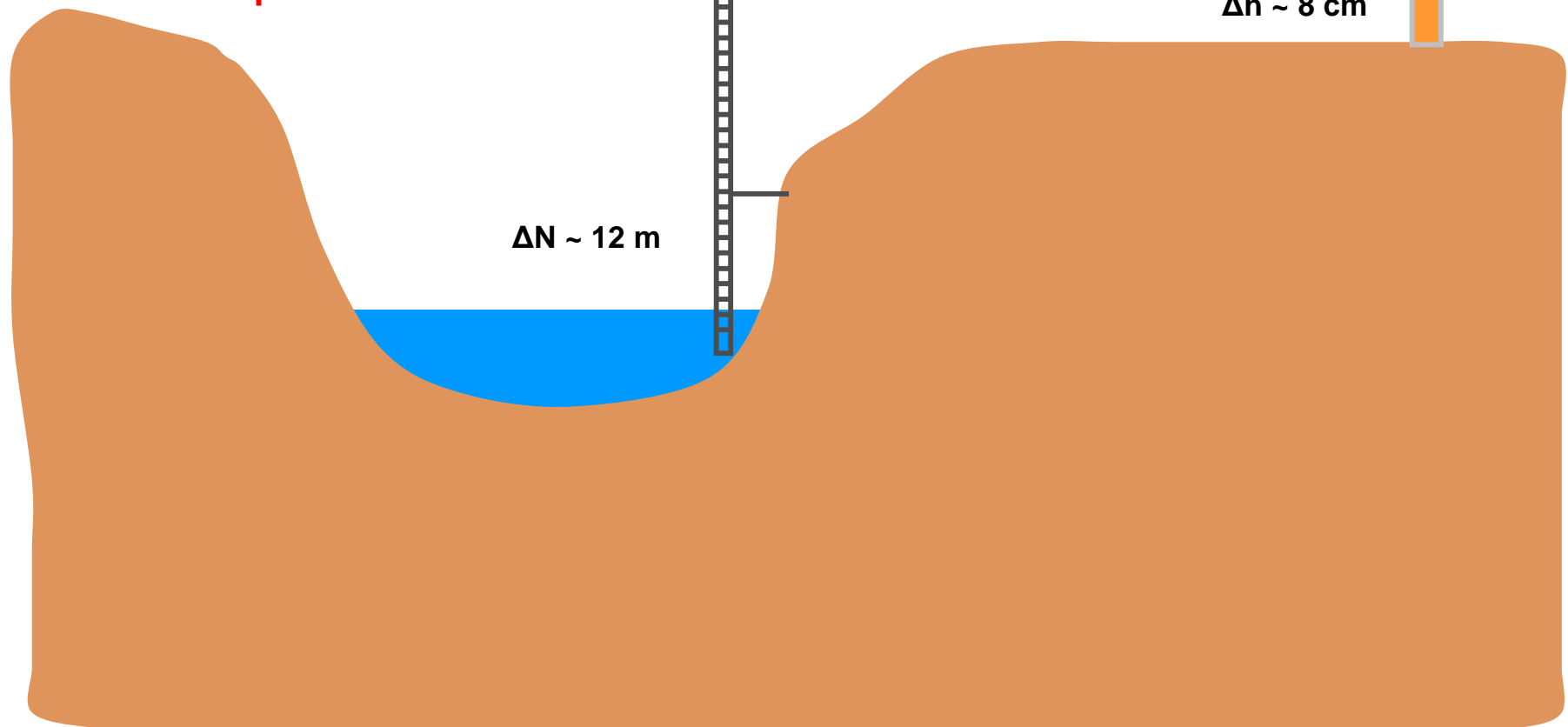
# Time Series – station NAUS x linmetric station



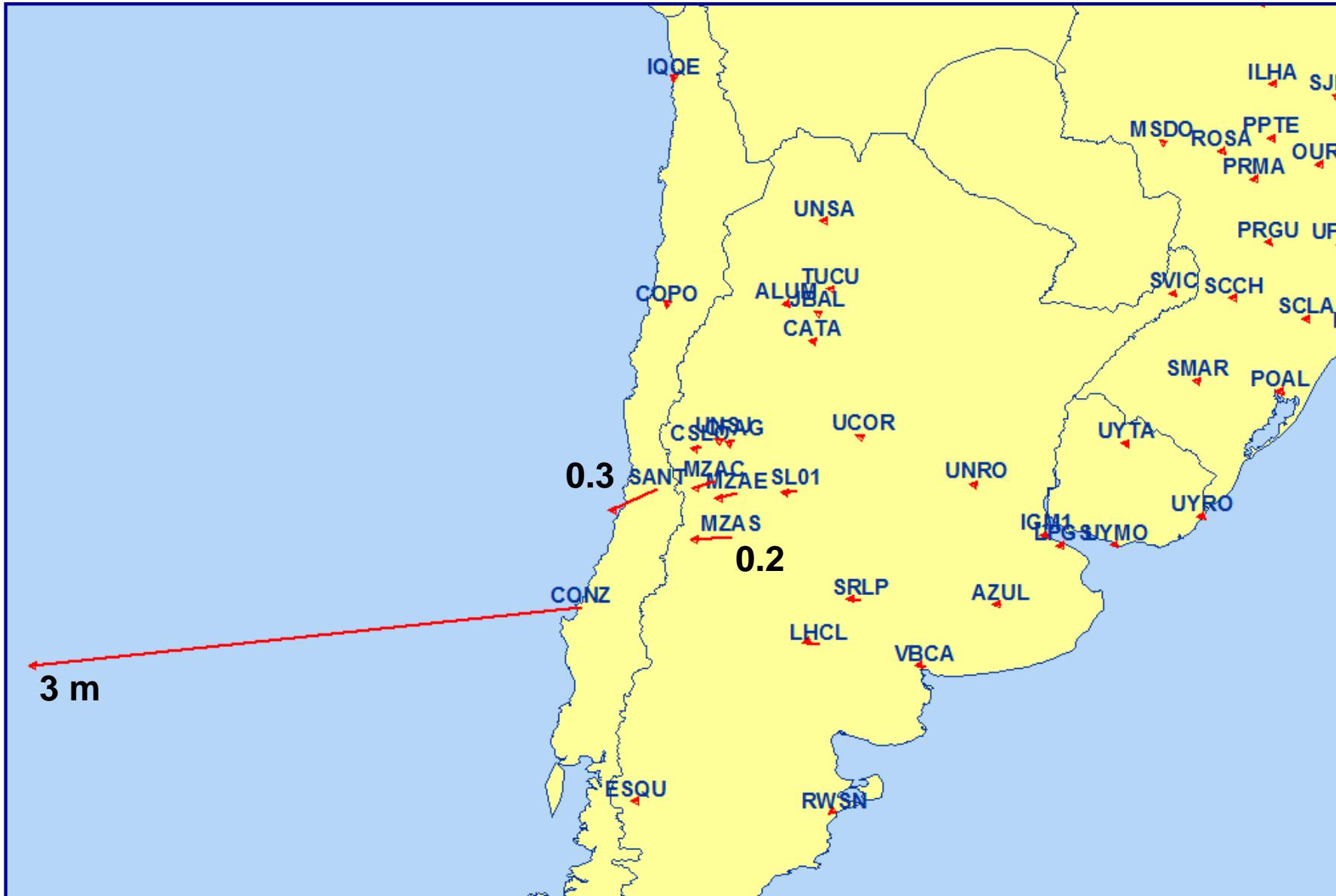
~ 13 km

$\Delta h \sim 8 \text{ cm}$

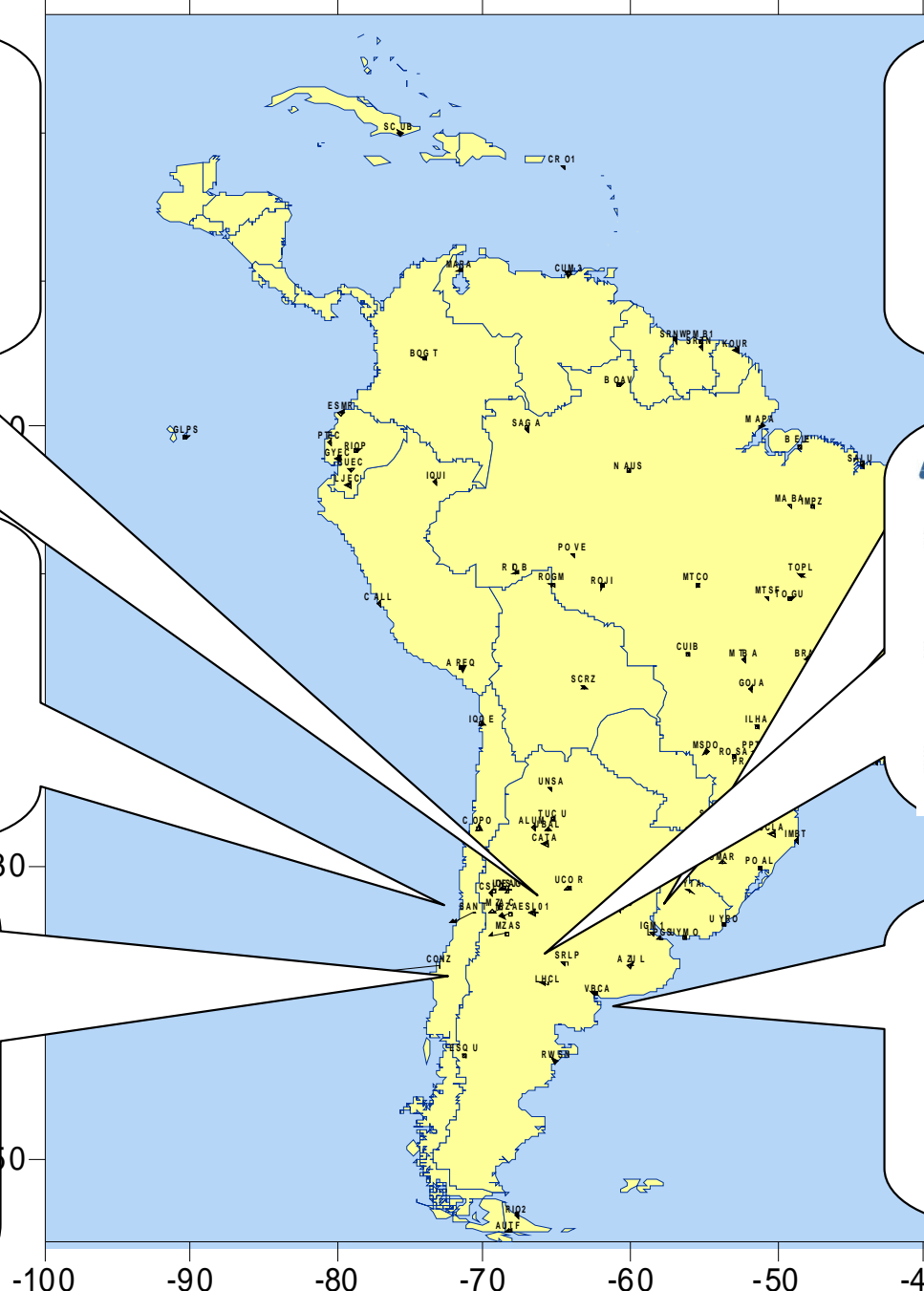
$\Delta N \sim 12 \text{ m}$



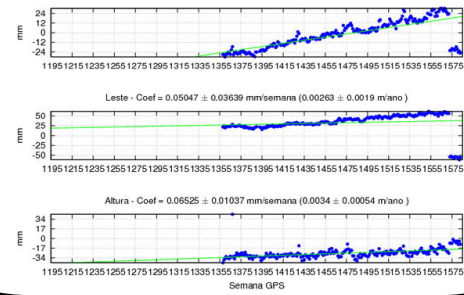
# Conception Eathquake



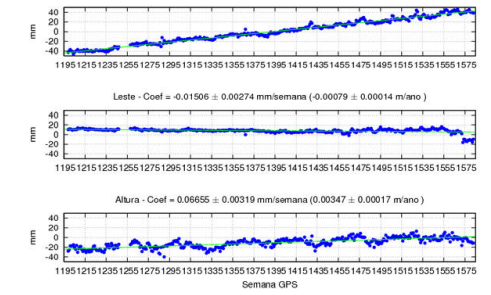
# Displacement due to Earthquake in Conception/Chile fev. 2010



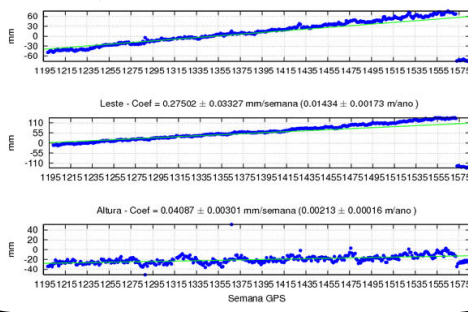
**IBGE** Mendoza 20 cm



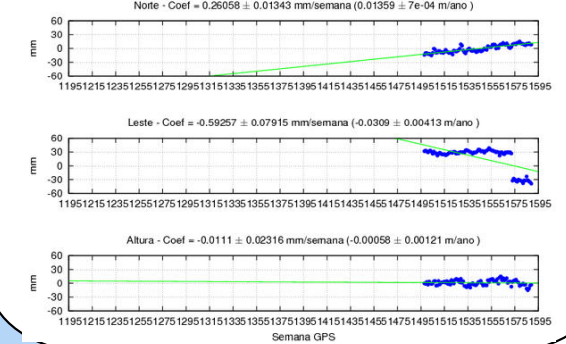
**IBGE** La Plata 2 cm



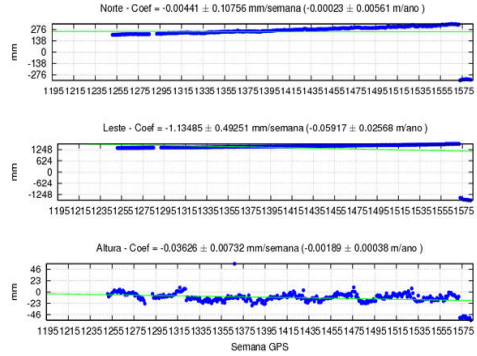
**IBGE** Santiago 30 cm



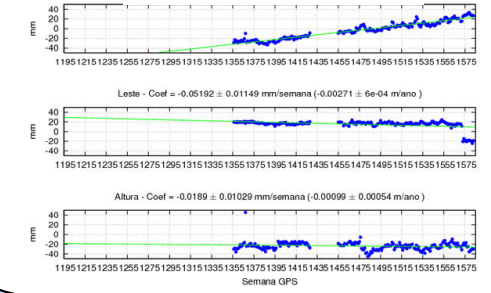
**IBGE** Santa Rosa 6 cm



**IBGE** Concepcion 2.9 m



**IBGE** Baia Blanca 4 cm





## Horizontal Displacements due to Earthquake

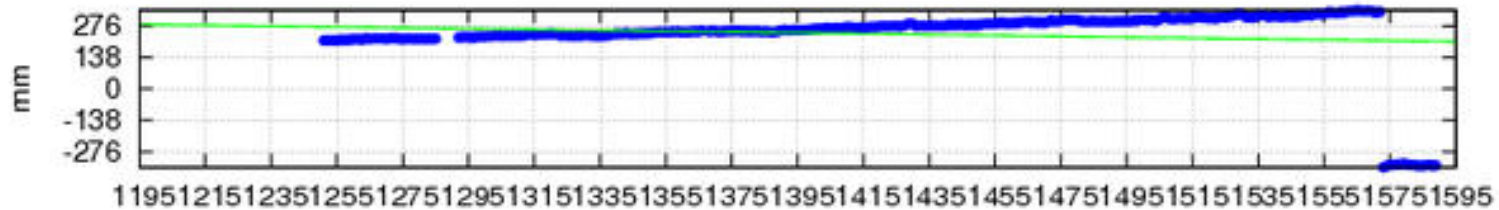
Station	Site/Country	Dist. ~ (km)	Displac. (cm)
CONZ	Concepción – Chile	115	297,8
SANT	Santiago – Chile	325	28,4
MZAS	San Rafael – Arg.	415	20,5
MZAC	Mendoza – Arg.	460	11,6
MZAE	Santa Rosa – Arg.	490	11,0
VALP	Valparaiso – Chile	290	7,7
LHCL	Lihuel Calel – Arg.	700	7,4
SL01	La Punta – Arg.	650	6,7
SRLP	Santa Rosa – Arg.	780	6,2
CSLO	Leoncito – Arg.	520	4,4
CFAG	Caucete – Arg.	610	4,0
VBCA	Bahia Blanca – Arg.	1000	3,6
UNSJ	Salta – Arg.	600	3,3
BRASIL			0,5 a 1,5 cm

# TIME SERIES: CONZ (CONCEPCIÓN)

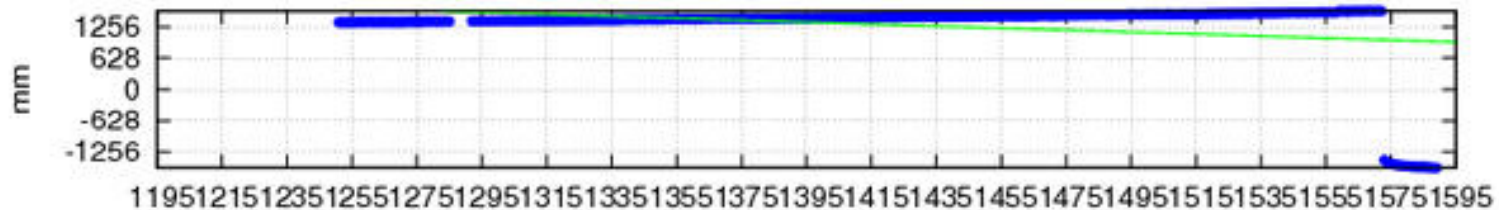


CONZ - Velocidade Planimetrica  $0.10402 \pm 0.02844$  m/ano

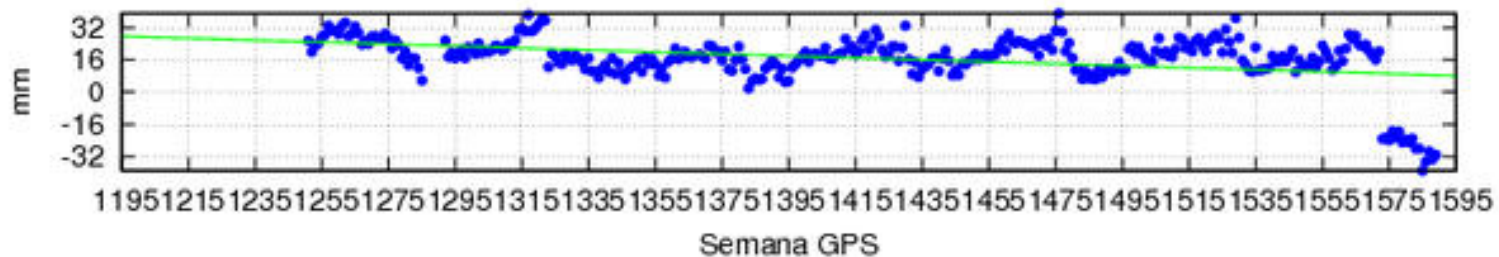
Norte - Coef =  $-0.18759 \pm 0.11684$  mm/semana ( $-0.00978 \pm 0.00609$  m/ano )



Leste - Coef =  $-1.98616 \pm 0.53274$  mm/semana ( $-0.10356 \pm 0.02778$  m/ano )



Altura - Coef =  $-0.04892 \pm 0.00839$  mm/semana ( $-0.00255 \pm 0.00044$  m/ano )



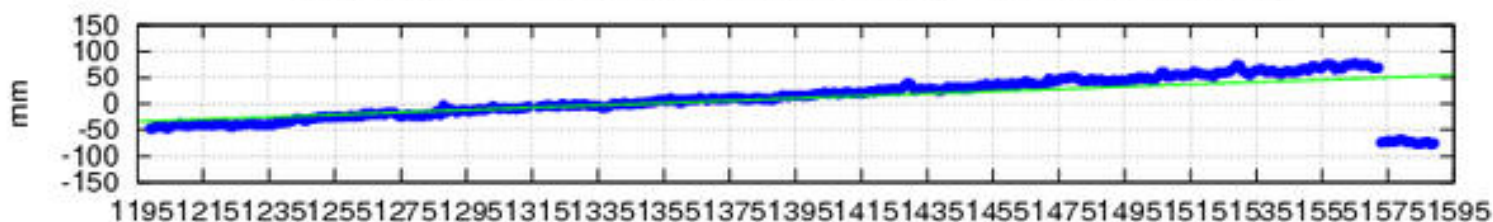
**Horizontal Displacement: 2,98 m (115 km)**

# TIME SERIES: SANT (SANTIAGO)

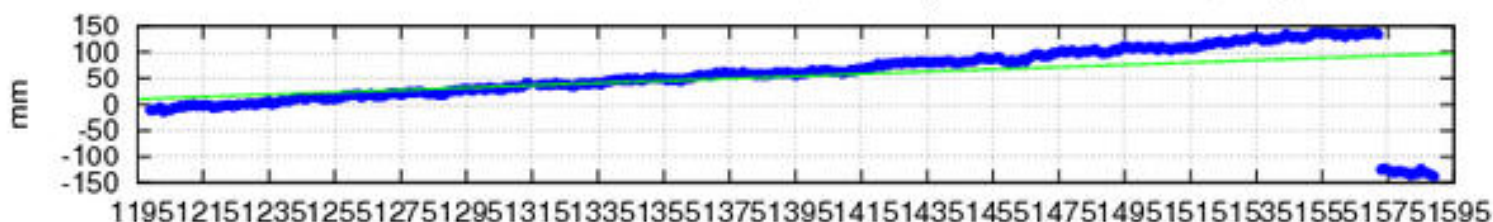


SANT - Velocidade Planimetrica  $0.01626 \pm 0.0022$  m/ano

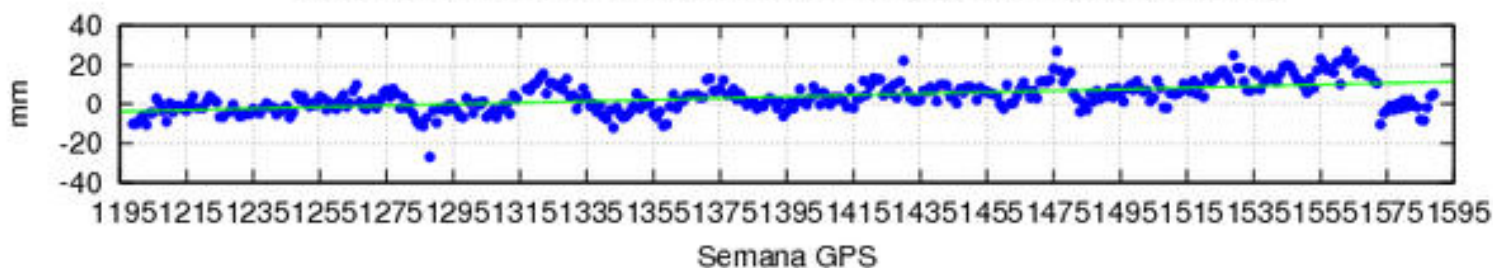
Norte - Coef =  $0.22217 \pm 0.02103$  mm/semana ( $0.01158 \pm 0.0011$  m/ano )



Leste - Coef =  $0.21876 \pm 0.03666$  mm/semana ( $0.01141 \pm 0.00191$  m/ano )



Altura - Coef =  $0.03808 \pm 0.0031$  mm/semana ( $0.00199 \pm 0.00016$  m/ano )



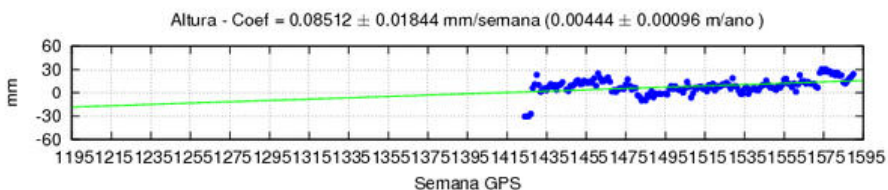
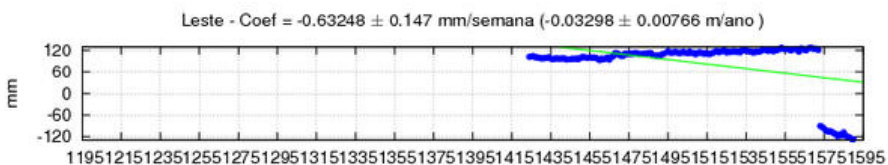
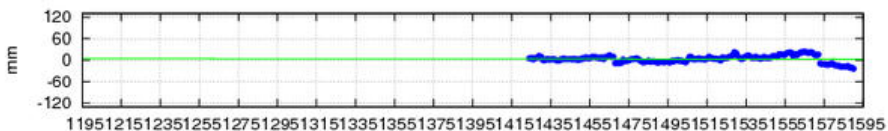
**Horizontal Displacement: 28,4 cm (325 km)**

# TIME SERIES: MENDOZA PROVINCE



MZAS - Velocidade Planimetrica  $0.03298 \pm 0.00773$  m/ano

Norte - Coef =  $-0.00327 \pm 0.01886$  mm/semana ( $-0.00017 \pm 0.00098$  m/ano )

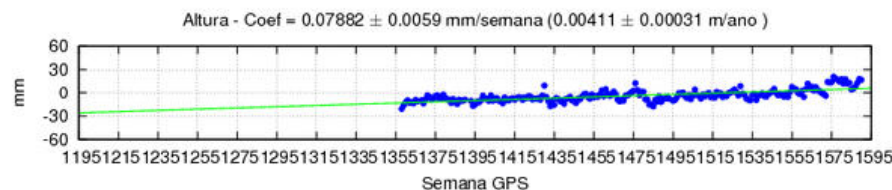
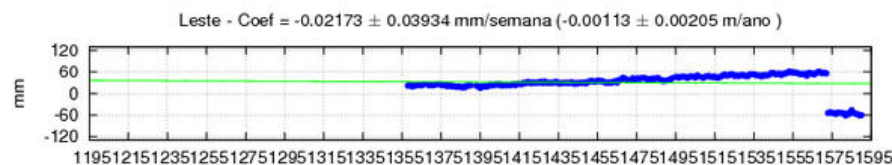
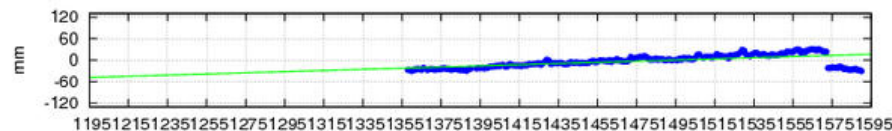


Horiz. Disp. : 20,5 cm (415 km)



MZAC - Velocidade Planimetrica  $0.00849 \pm 0.00228$  m/ano

Norte - Coef =  $0.16136 \pm 0.01909$  mm/semana ( $0.00841 \pm 0.001$  m/ano )

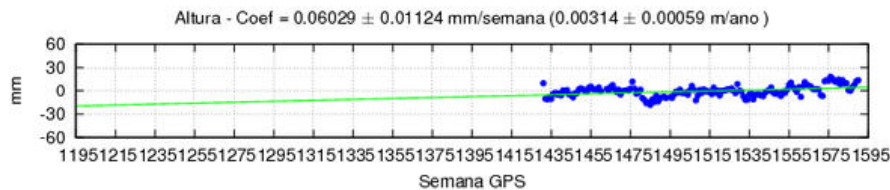
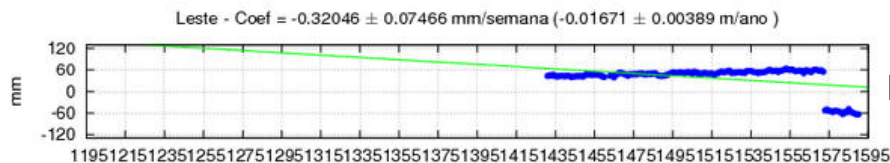
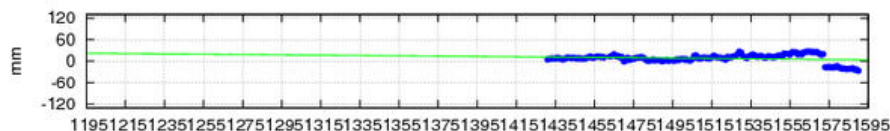


Horiz. Disp. : 11,6 cm (460 km)



MZAE - Velocidade Planimetrica  $0.01688 \pm 0.00413$  m/ano

Norte - Coef =  $-0.04572 \pm 0.02669$  mm/semana ( $-0.00238 \pm 0.00139$  m/ano )



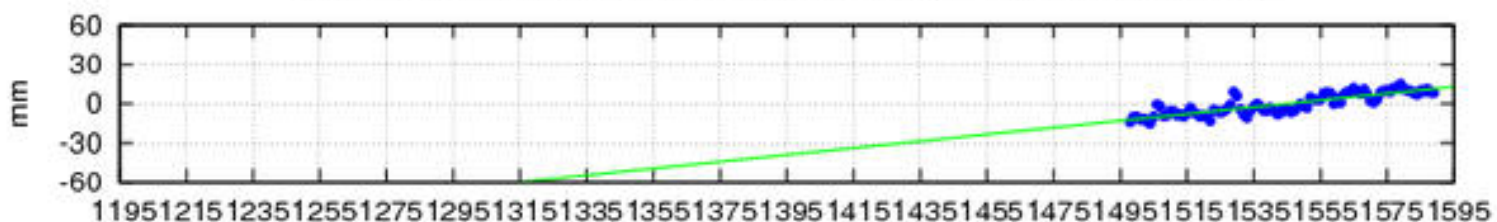
Horiz. Disp.: 11,0 cm (490 km)

# TIME SERIES: SRLP (SANTA ROSA)

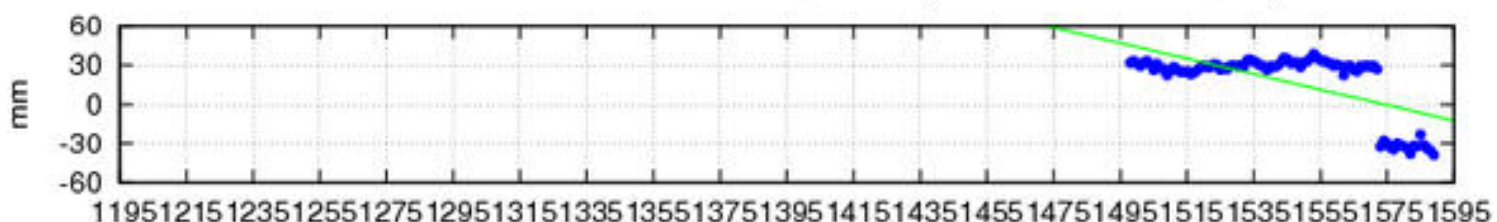


SRLP - Velocidade Planimetrica  $0.03375 \pm 0.00419$  m/ano

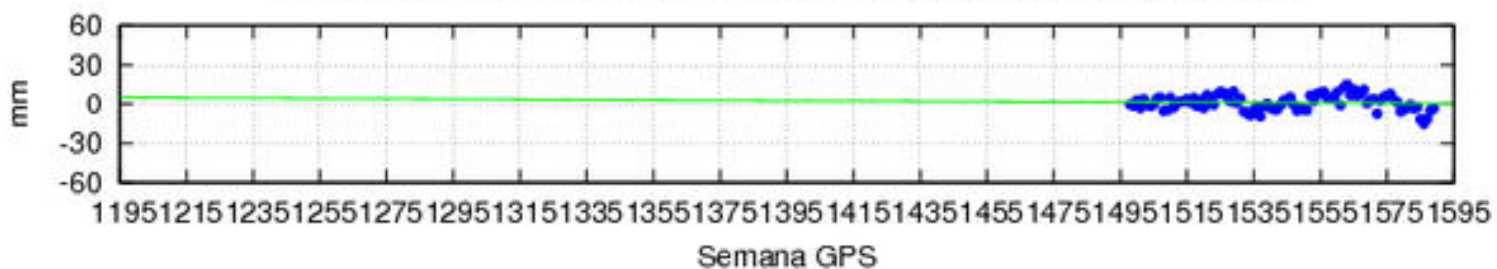
Norte - Coef =  $0.26058 \pm 0.01343$  mm/semana ( $0.01359 \pm 7e-04$  m/ano )



Leste - Coef =  $-0.59257 \pm 0.07915$  mm/semana ( $-0.0309 \pm 0.00413$  m/ano )



Altura - Coef =  $-0.0111 \pm 0.02316$  mm/semana ( $-0.00058 \pm 0.00121$  m/ano )



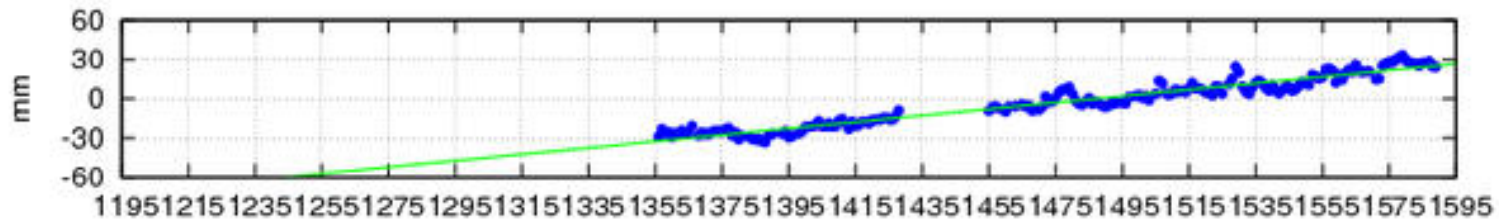
**Horizontal Displacement: 6,2 cm (780 km)**

# TIME SERIES: VBCA (BAHIA BLANCA)

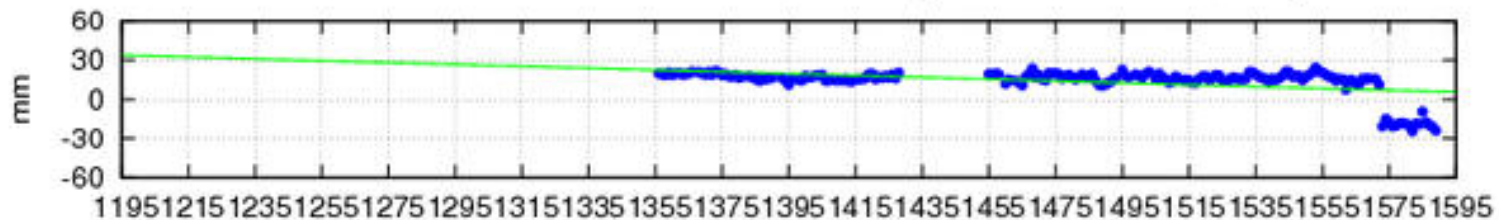


VBCA - Velocidade Planimetrica  $0.01339 \pm 0.00067$  m/ano

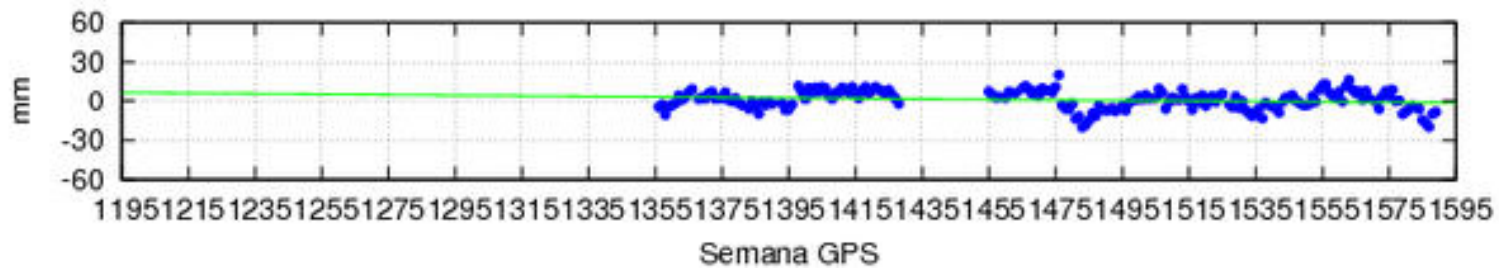
Norte - Coef =  $0.24697 \pm 0.00466$  mm/semana ( $0.01288 \pm 0.00024$  m/ano )



Leste - Coef =  $-0.07047 \pm 0.01207$  mm/semana ( $-0.00367 \pm 0.00063$  m/ano )



Altura - Coef =  $-0.01937 \pm 0.0065$  mm/semana ( $-0.00101 \pm 0.00034$  m/ano )



**Horizontal Displacement: 3,6 cm (1000 km)**

# Analysis Centre Website

[http://www.ibge.gov.br/home/geociencias/geodesia/centros\\_apresenta.htm](http://www.ibge.gov.br/home/geociencias/geodesia/centros_apresenta.htm)

## Geodésia

### Introdução

#### SGB

- ▶ Introdução
- ▶ Rede Planimétrica
- ▶ Rede Altimétrica
- ▶ Rede Gravimétrica
- ▶ Redes Estaduais GPS
- ▶ Banco de Dados
- ▶ Modelo Geoidal

#### PPP

- ▶ Introdução

#### RBMC

- ▶ Introdução
- ▶ Estações
- ▶ Informações
- ▶ Download
- ▶ RBMC-IP
- ▶ Cadastro

#### RMPG

- ▶ Introdução
- ▶ Estações
- ▶ Download

#### SIRGAS

- ▶ **Centro de Análise SIRGAS**
- ▶ Centro de Processamento
  - ▶ Resultados
  - ▶ Estações Processadas
  - ▶ Relatórios
  - ▶ Gráficos
- ▶ Centro de Combinação
  - ▶ Resultados
  - ▶ Estratégia
  - ▶ Relatórios

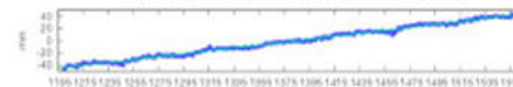
### SIRGAS - Sistema de Referência Geocêntrico para as Américas



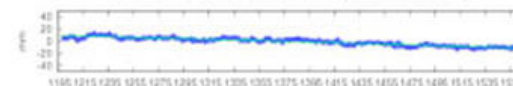
IBGE

RICO - Velocidade Paramétrica 0.01265 ± 1e-05 m/ano

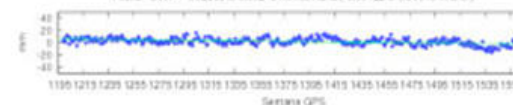
Norte - Coef = 0.23994 ± 0.0011 mm/semana (0.24251 ± 6e-05 m/ano)



Leste - Coef = -0.05612 ± 0.00127 mm/semana (-0.00293 ± 7e-05 m/ano)

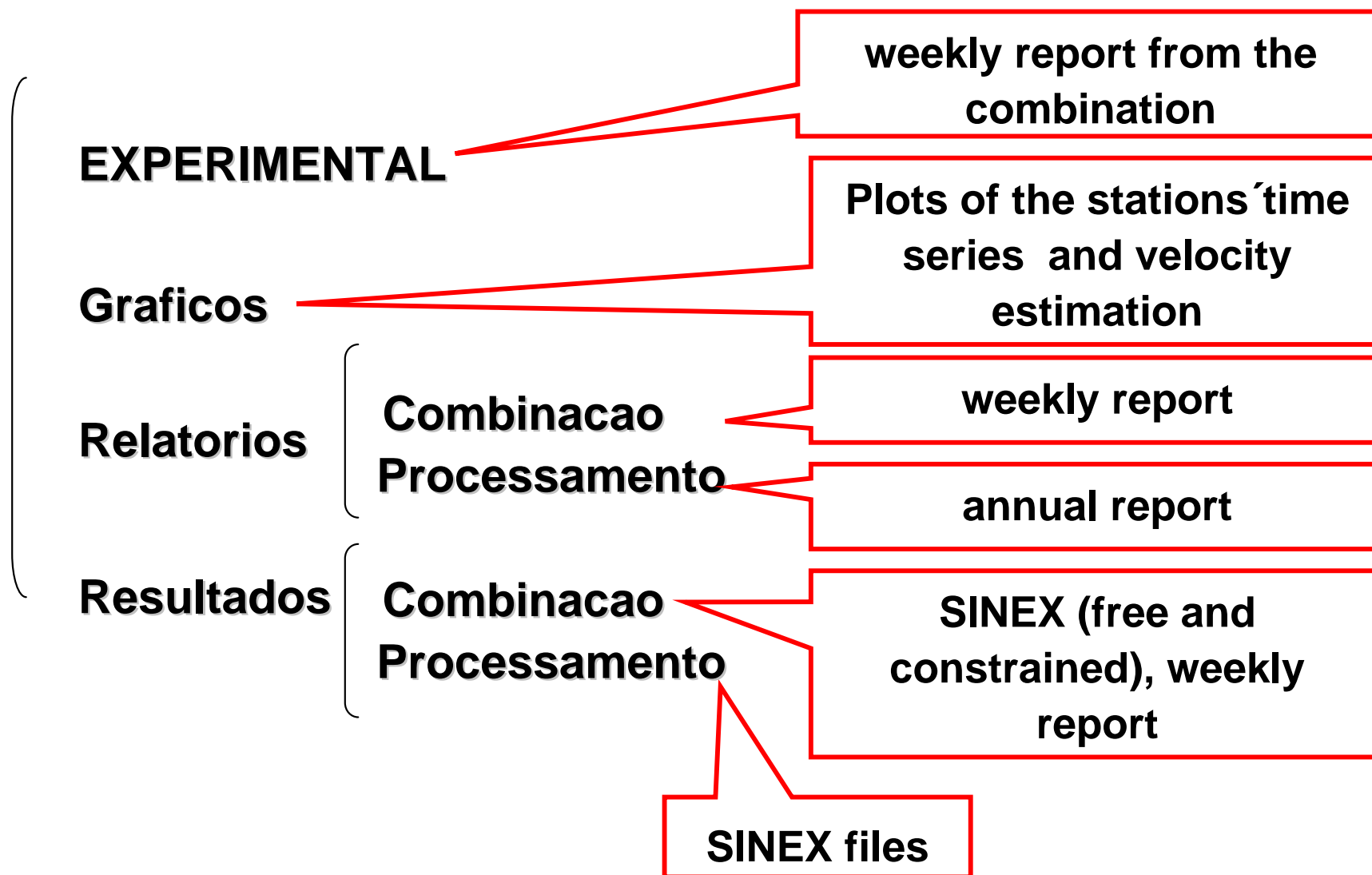


Altim - Coef = -0.00330 ± 0.00245 mm/semana (-0.00122 ± 0.00013 m/ano)



Seriana GPS

Results : <ftp://geoftp.ibge.gov.br/SIRGAS/>





**Thank you very much for your  
attention!**

**For more information:**

**Coordination of Geodesy – CGED**

**<http://www.ibge.gov.br/home/geociencias/geodesia/default.shtm>**

**e-mail: [geodesia@ibge.gov.br](mailto:geodesia@ibge.gov.br)**

**Geodetic data base:**

**<http://mapas.ibge.gov.br/website/geodesia>**

**Data Download:**

**<ftp://geofp.ibge.gov.br>**