Recent IBGE Activities and Results as SIRGAS Analysis Center

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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 is a regional densification of the ITRF in South and Central Americas and Caribean 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)
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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

<table>
<thead>
<tr>
<th>Processing Date</th>
<th>Week 1199 to 1400</th>
<th>After week 1400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>Double Difference</td>
<td>Double Difference</td>
</tr>
<tr>
<td>Software used</td>
<td>Bernese 5.0 (BPE mode)</td>
<td>Bernese 5.0 (BPE mode)</td>
</tr>
<tr>
<td>Sampling rate</td>
<td>30 sec</td>
<td>30 sec</td>
</tr>
<tr>
<td>Elevation angle</td>
<td>10°</td>
<td>03°</td>
</tr>
<tr>
<td>Baseline formation strategy</td>
<td>SHORTEST</td>
<td>SHORTEST</td>
</tr>
<tr>
<td>Orbits/EOP</td>
<td>IGS final - ITRF2000/IGb00 EOP week</td>
<td>IGS final - IGS05 EOP week</td>
</tr>
<tr>
<td>A priori troposphere model</td>
<td>Niell dry component</td>
<td>Niell dry component</td>
</tr>
<tr>
<td>Troposphere</td>
<td>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</td>
<td>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</td>
</tr>
<tr>
<td>Ambiguity</td>
<td>QIF strategy with GIM from CODE</td>
<td>QIF strategy with GIM from CODE</td>
</tr>
<tr>
<td>Ocean Loading Model</td>
<td>GOT00.2</td>
<td>FES2004</td>
</tr>
<tr>
<td>Phase Center Variation</td>
<td>Absolute (IGS_05) and Relative</td>
<td>Absolute (IGS_05)</td>
</tr>
<tr>
<td>Apriori Coord. and Vel.</td>
<td>IGSb00</td>
<td>IGS05_R</td>
</tr>
<tr>
<td>Daily solutions</td>
<td>Minimum constraint in stations BRAZ coordinates (σ=±1mm) OUTPUT FILES: SINEX Troposphere maps</td>
<td>Constraint in all stations (σ=±1m) OUTPUT FILES: SINEX Troposphere maps</td>
</tr>
<tr>
<td>Weekly solutions</td>
<td>12 IGS stations are used to constrain weekly solution (σ=±0.1mm) OUTPUT FILES: SINEX</td>
<td>All stations constrained (σ=±1m) OUTPUT FILES: SINEX</td>
</tr>
</tbody>
</table>
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

North

East

Up
Stations’ Velocities
Estimated Velocities: IBGE x VEMOS2009
Anual Variation of Up Component

- Boa Vista
- Macapa
- Imperatriz
- Cuiabá
- Guajara-Mirim
- Porto Velho
- Manaus
- Marabá

Map showing locations and graphs for each city.
Distance between two stations (GNSS / linmetric)

13 km
Time Series – station NAUS x linmetric station
Time Series – station NAUS x linmetric station

LINÍGRAFO x GPS - (Normalizado 1 e -1)

-1.0
-0.6
-0.2
0.2
0.6
1.0

Variação (-1,1)

~ 13 km

Δh ~ 8 cm

ΔN ~ 12 m
Conception Earthquake

3 m
Displacement due to Earthquake in
Conception/Chile fev. 2010

- Mendoza 20 cm
- La Plata 2 cm
- Santiago 30 cm
- Santa Rosa 6 cm
- Concepcion 2.9 m
- Baia Blanca 4 cm

Displacement in cm:
- Concepcion: 2.9 m
- Santiago: 30 cm
- Santa Rosa: 6 cm
- Baia Blanca: 4 cm
- La Plata: 2 cm
- Mendoza: 20 cm
## Horizontal Displacements due to Earthquake

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

Horizontal Displacement: 2.98 m (115 km)
TIME SERIES: SANT (SANTIAGO)

Horizontal Displacement: 28.4 cm (325 km)
TIME SERIES: MENDOZA PROVINCE

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

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

Horiz. Disp.: 11,0 cm (490 km)
TIME SERIES: SRLP (SANTA ROSA)

Horizontal Displacement: 6,2 cm (780 km)
TIME SERIES: VBCA (BAHIA BLANCA)

Horizontal Displacement: 3,6 cm (1000 km)
Analysis Centre Website

http://www.ibge.gov.br/home/geociencias/geodesia/centros_apres.shtm

SIRGAS - Sistema de Referência Geocêntrico para as Américas

Centro de Análise SIRGAS

Centro de Processamento

Resultados

Estações Processadas

Relatórios

Gráficos

Centro de Combinação

Resultados

Estação

Relatórios
Results: ftp://geoftp.ibge.gov.br/SIRGAS/

EXPERIMENTAL

Graficos

Relatorios

Resultados

weekly report from the combination

Plots of the stations’ time series and velocity estimation

weekly report

annual report

SINEX (free and constrained), weekly report

SINEX files
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

Geodetic data base:
http://mapas.ibge.gov.br/website/geodesia

Data Download:
ftp://geoftp.ibge.gov.br