PROCESSING EVALUATION OF SIRGAS-CON NETWORK BY IBGE ANALYSIS CENTER

Sonia Maria Alves Costa
Alberto Luis da Silva
Jhonnes Alberto Vaz

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Motivation

- IBGE is responsible for the definition, maintenance and provide the access to the National Spatial Reference System ➔ Brazilian Geodetic System - SGB;
- 1997: Started the establishment of the active geodetic network ➔ Brazilian Network for Continuous Monitoring of GNSS (RBMC) ➔ The main Reference Frame in the country
- 2005: Adoption of Geocentric Reference System for the Americas – SIRGAS, SIRGAS2000
- 2006: Network expansion from 24 to 66 (july 2009)

SIRGAS Processing Center– IBGE

- ✓ **The network maintenance and control is done through the daily data processing.**
- ✓ **Monitoring the temporal variation of the coordinates together with the data quality;**
- ✓ **Data processing since January 2003 (GPS week 1199);**
- ✓ **Software: Bernese GPS Software 5.0 – BPE;**
- ✓ **Results: Daily and weekly (combined) loosely constrained solutions in SINEX format (IBG*wwww*7.SNX).**

SIRGAS-CON Network

- Currently, SIRGAS Reference Frame is realized by 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, (46 are part of the IGS network).

- SIRGAS Analysis Centers: american institutions with the task to provide control of the permanent stations and maintenance of SIRGAS Reference Frame;

SIRGAS Analysis Centers

- **Local Processing Centers:**
  - ✓ **Instituto Brasileiro de Geografia e Estatística - IBGE;**
  - ✓ **Instituto Geográfico Agustín Codazzi – IGAC;**
  - ✓ **Instituto de Geodésia e Geodinâmica da Universidade Nacional de Cuyo, IGG-CIMA;**

- **IGS Regional Analysis Center – IGS-RNAAC-SIR:**
  - ✓ **Deutsches Geodätisches Forschungsintitut – DGFI;**

- **Combination Centers:**
  - ✓ **Instituto Brasileiro de Geografia e Estatística – IBGE;**
  - ✓ **Deutsches Geodätisches Forschungsintitut – DGFI;**

SIRGAS-CON Network

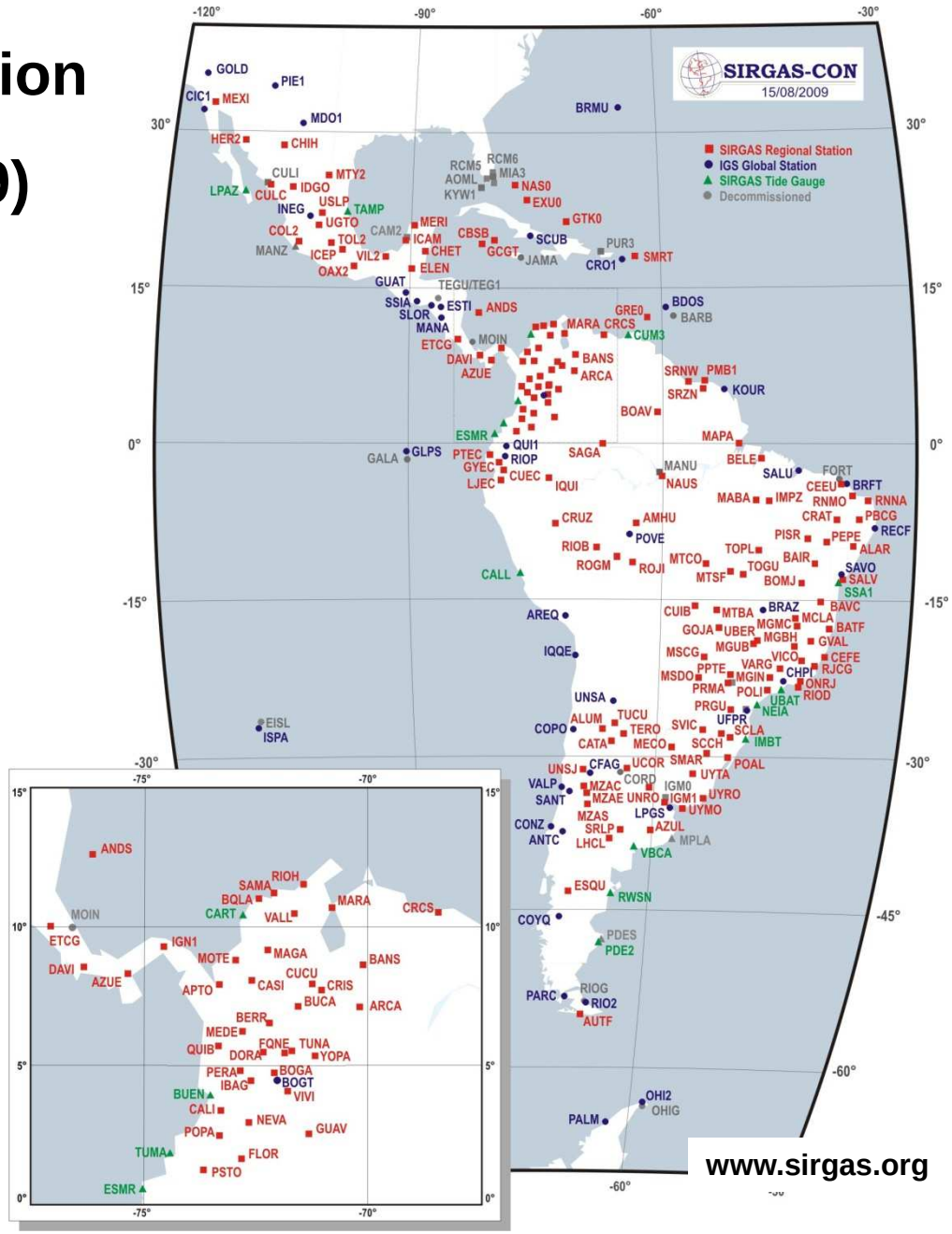
- **Due to the increasing number of SIRGAS-CON stations, it was divided in two levels :**

- **(1) SIRGAS-CON-C ➔Core network, the densification of the ITRF in Latin America, with stable fundamental stations that guarantee the consistency and precision of SIRGAS over time.**

- **(2) SIRGAS-CON-D ➔ a network composed of several national densifications, including the reference stations of SIRGAS-CON-C.**

SIRGAS-CON Realization

(status : August 2009)



www.sirgas.org

SIRGAS Analysis Centers (2/2)

- **Experimental Processing Centers:**
  - ✓ **Serviço Geográfico Militar do Uruguai – SGM-UY;**
  - ✓ **Laboratório de Geodésia Física e Satelital, Universidade de Zulia – LGFS-LUZ;**
  - ✓ **Instituto Geográfico Militar do Equador, IGM-Ec;**
  - ✓ **Instituto Nacional de Estatística e Geografia, INEGI (México)**
  - ✓ **Instituto Geográfico Nacional da Argentina (IGN-Ar)**

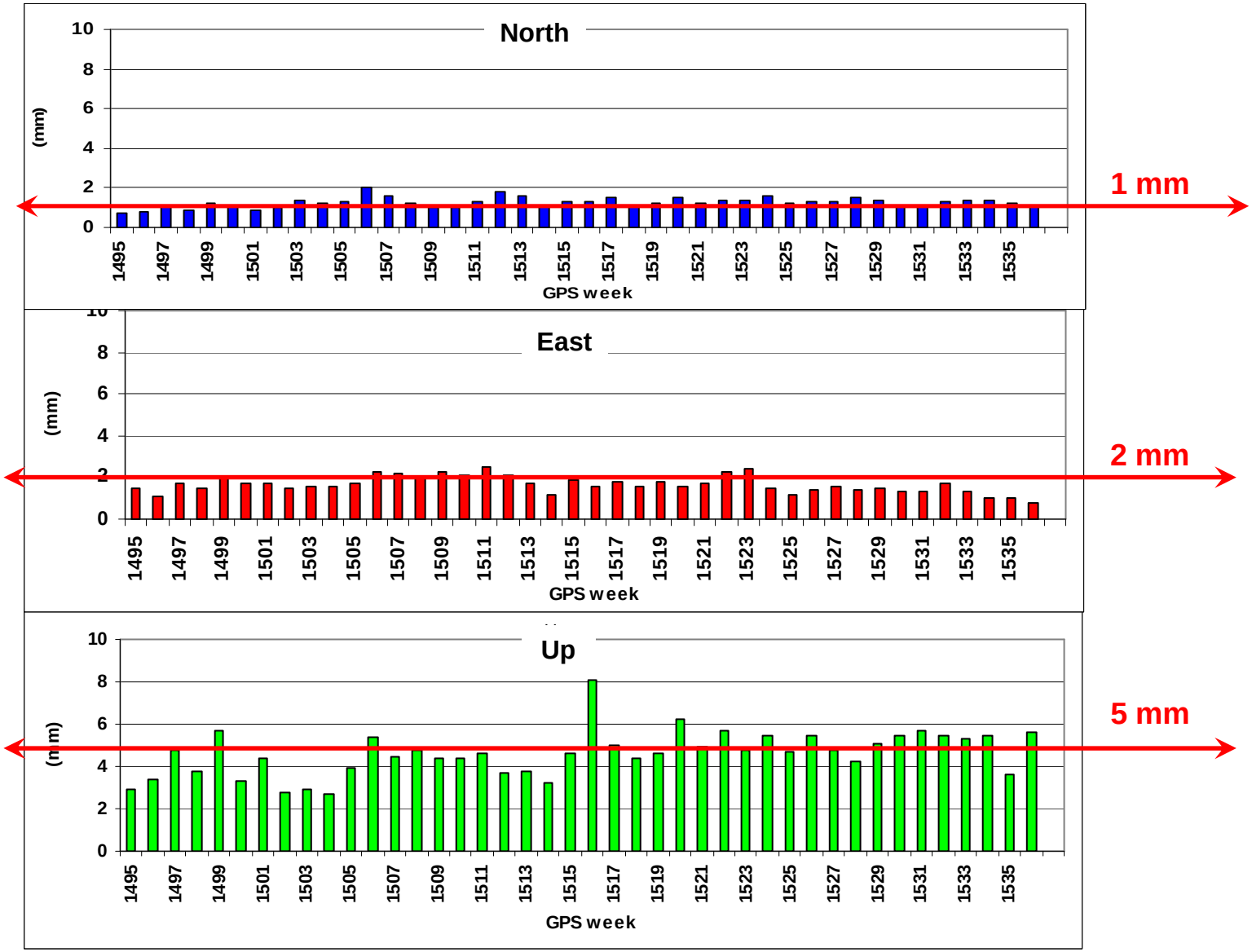
Currently Processed Stations - IBGE

- **> 100 stations:**
  - **31 IGS stations**
  - **> 70 regional stations**

Processing Strategy

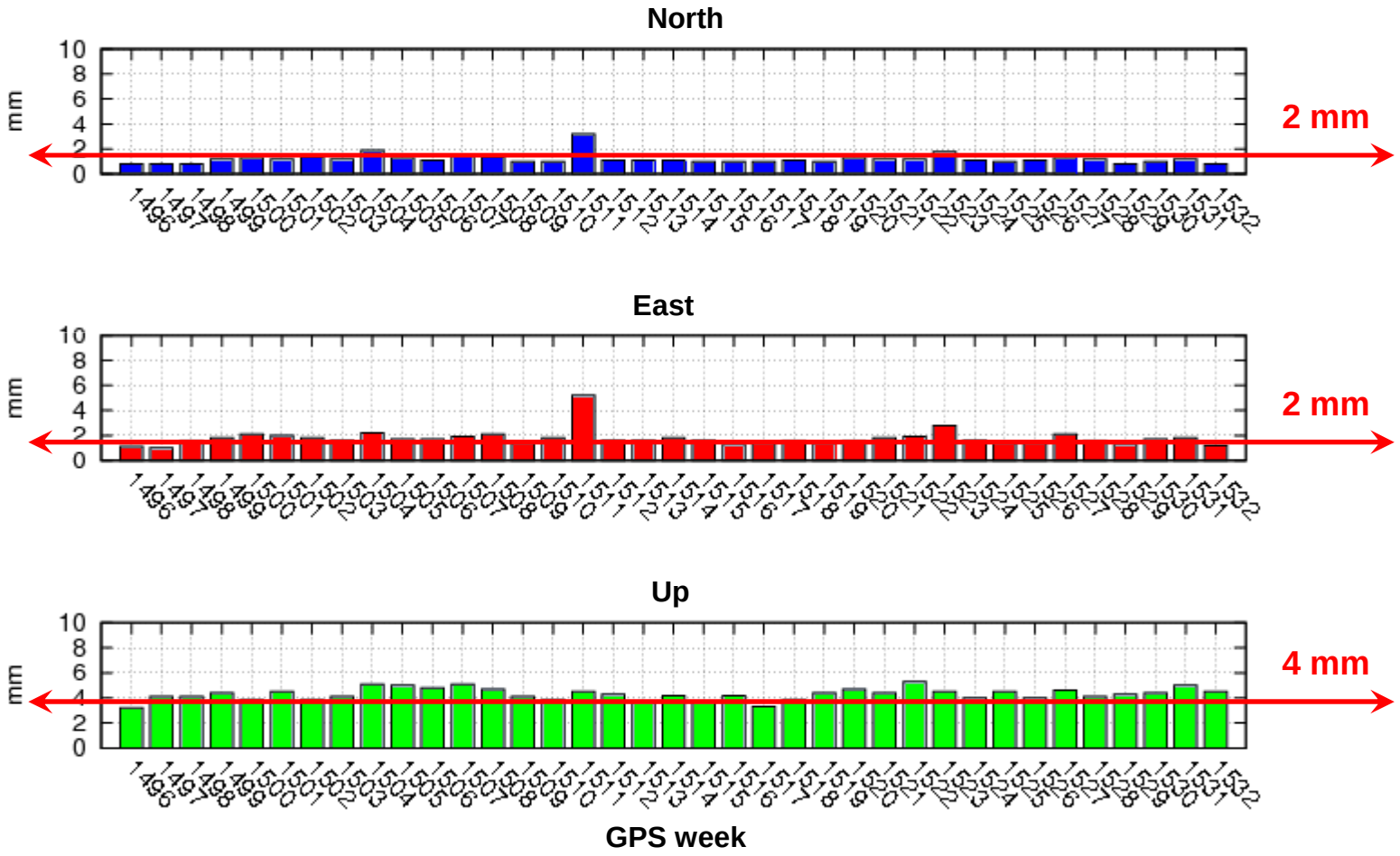
Processing Date	Week 1199 to 1400	After week 1400
Observations	Double Difference	Double Difference
Software used	Bernese 5.0 (BPE mode)	Bernese 5.0 (BPE mode)
Sampling rate	30 sec	30 sec
Elevation angle	10º	03º
Baseline formation strategy	SHORTEST	SHORTEST
Orbits/EOP	IGS final - ITRF2000/IGb00 EOP week	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)
Coordinates and Velocities	IGSb00	IGS05_R
Daily solutions	Constraint solution in station BRAZ ($\sigma = \pm 1$mm) OUTPUT FILES: SINEX	Constraint all the stations ($\sigma = \pm 1$m) OUTPUT FILES: SINEX
Weekly solutions	4 IGS stations - (BRAZ, LPGS, RIOG and SANT) are used to constrain the weekly solution($\sigma = \pm 1$mm) OUTPUT FILES: SINEX	All stations constrained ($\sigma = \pm 1$m) OUTPUT FILES: SINEX

Residuals RMS (weekly solutions) – IBGE X IGS05



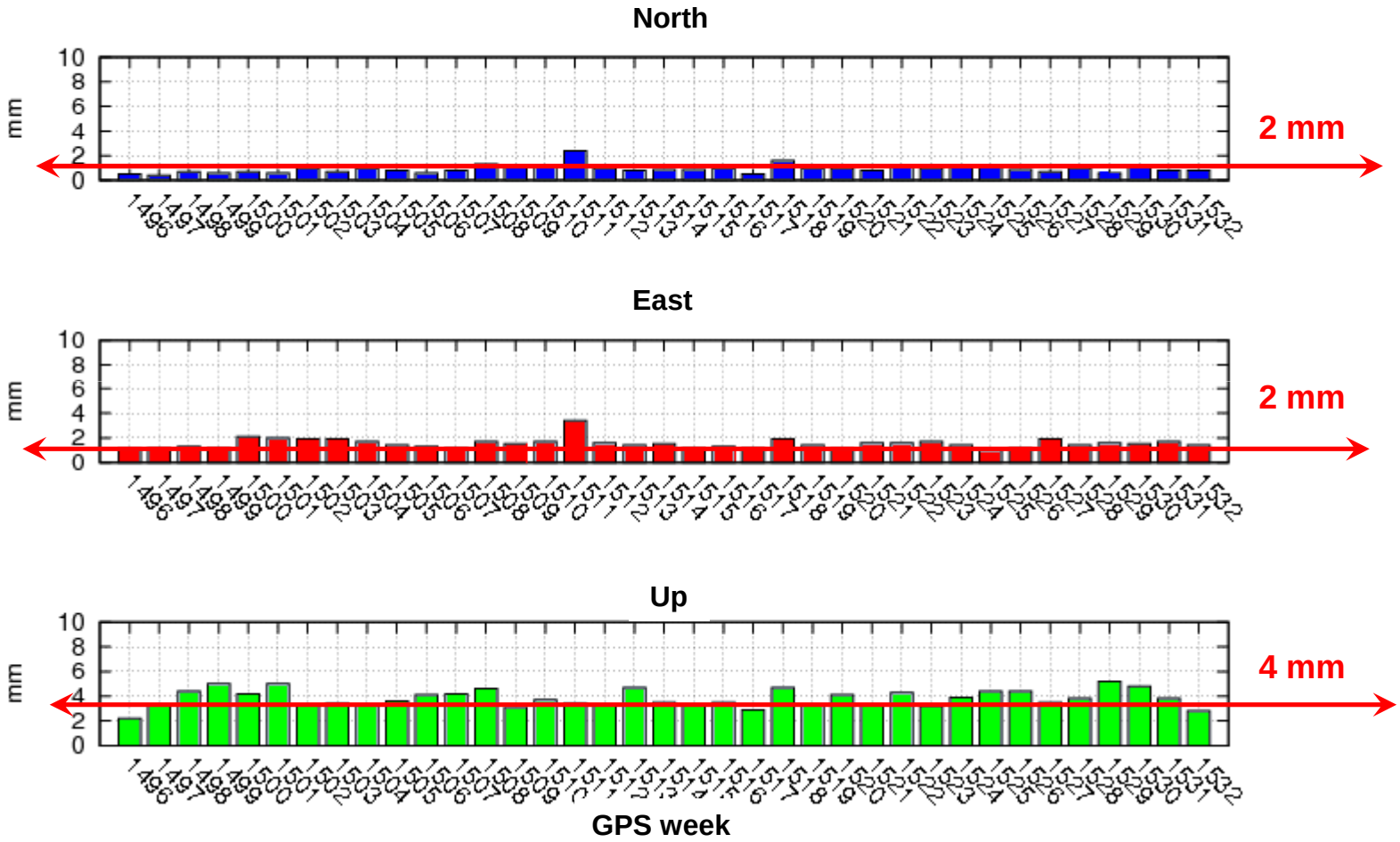
Residuals RMS (weekly solutions) – IBGE X DGFI

Weekly Root Mean Square ➔ IBGE X DGFI



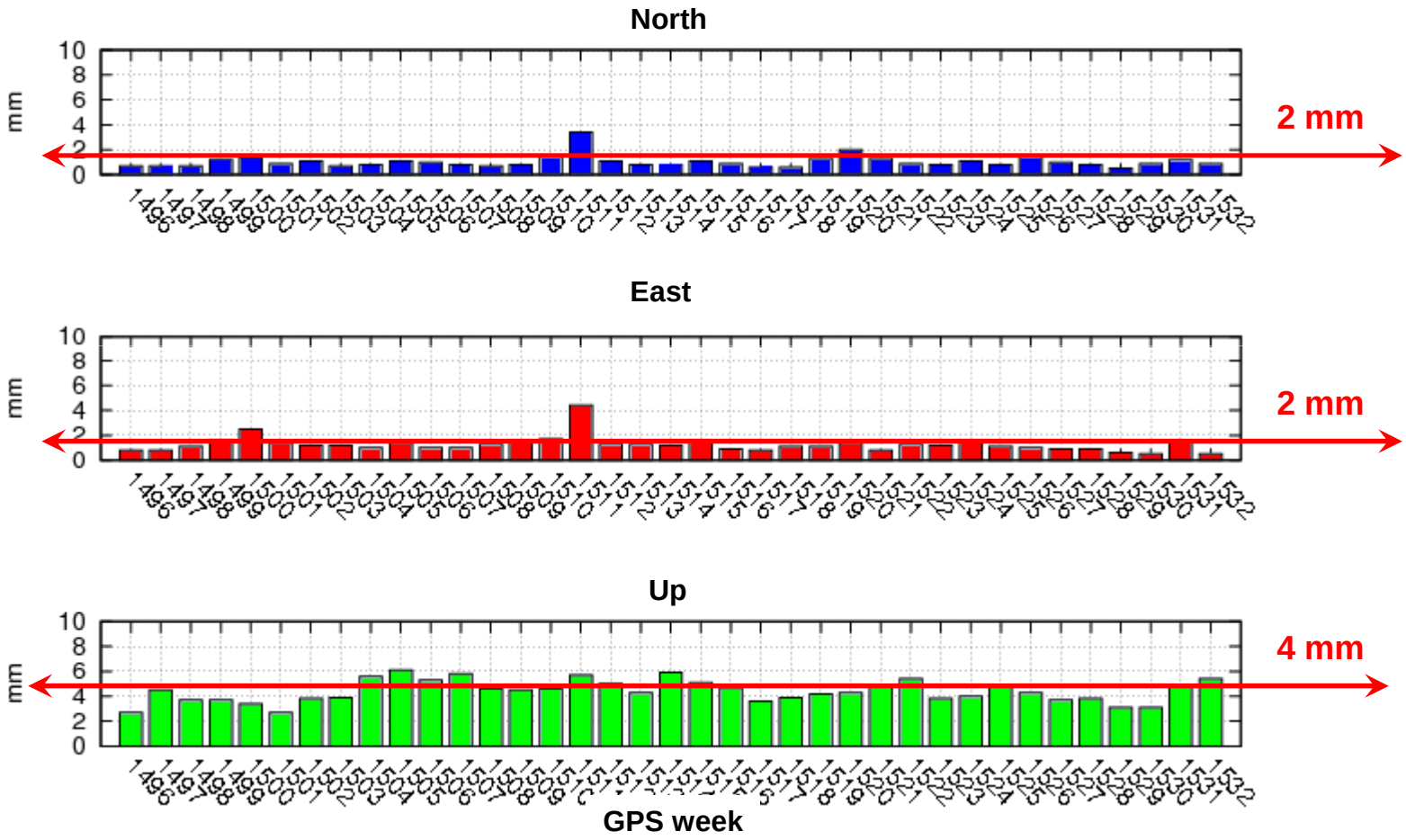
Residuals RMS (weekly solutions) – IBGE X CIMA

Weekly Root Mean Square ➔ IBGE X CIMA



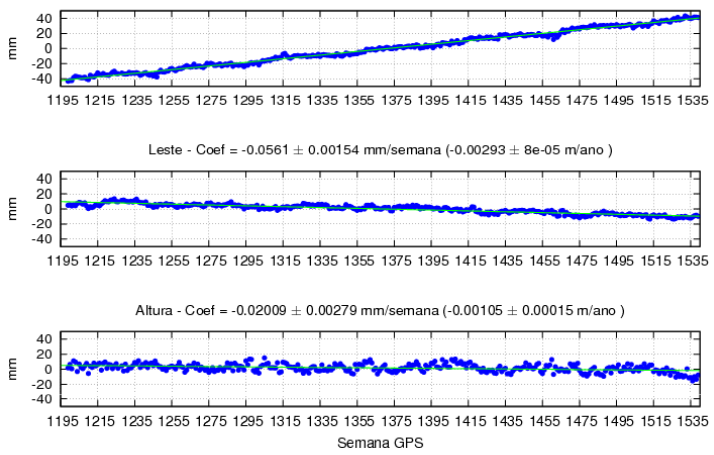
Residuals RMS (weekly solutions) – IBGE X IGAC

Weekly Root Mean Square ➔ IBGE X IGAC

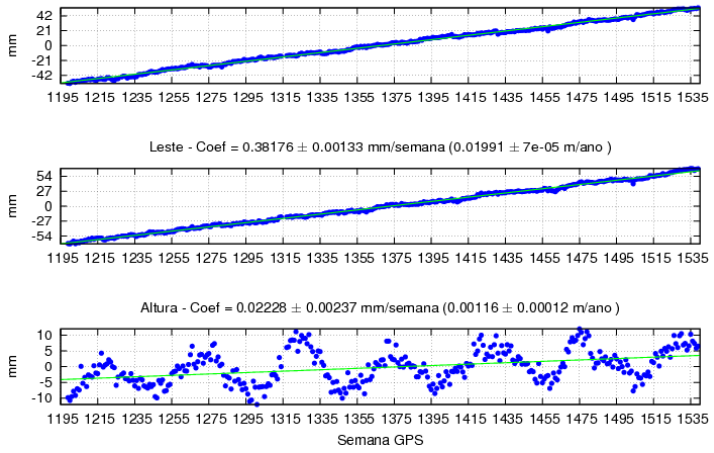


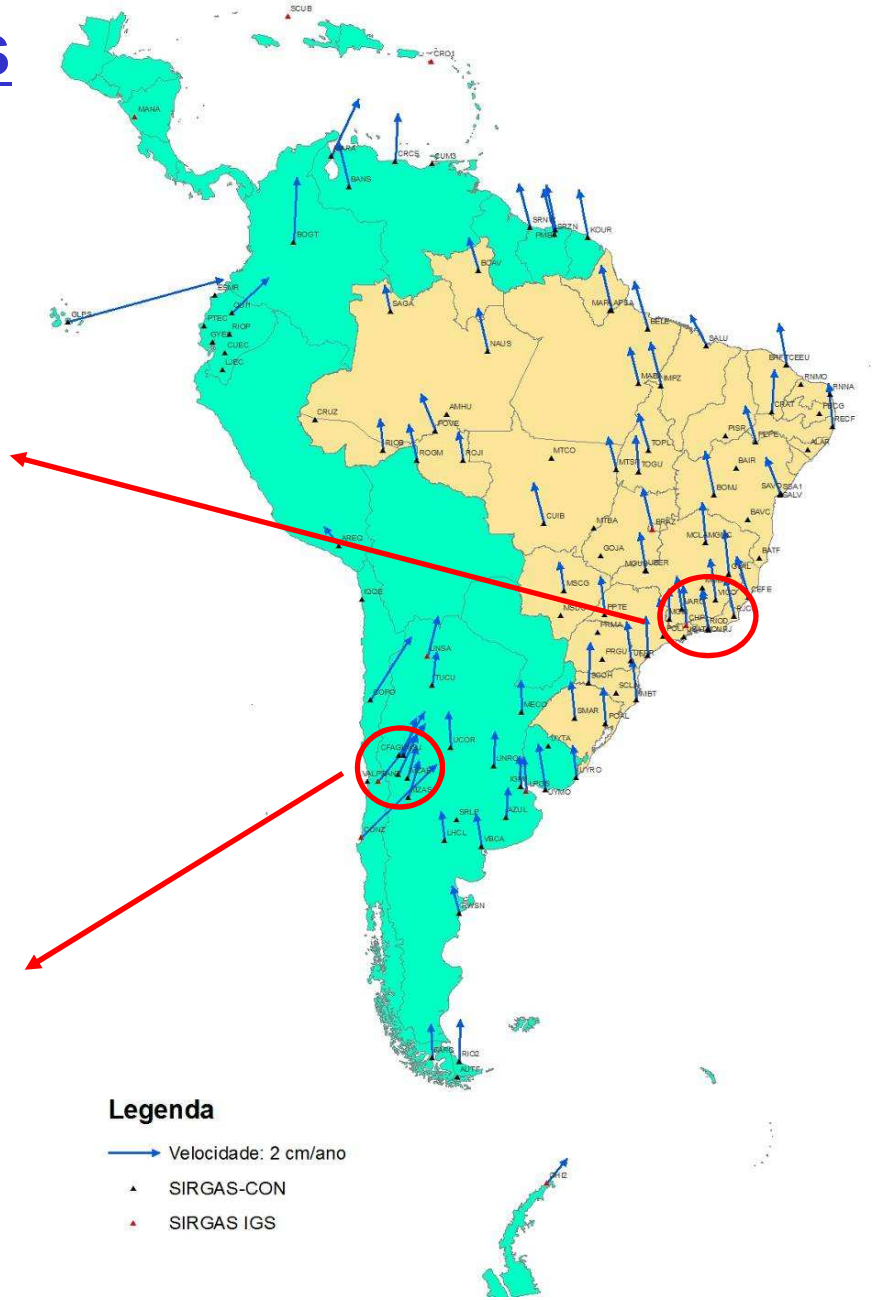
Estimated Velocities

RIOD



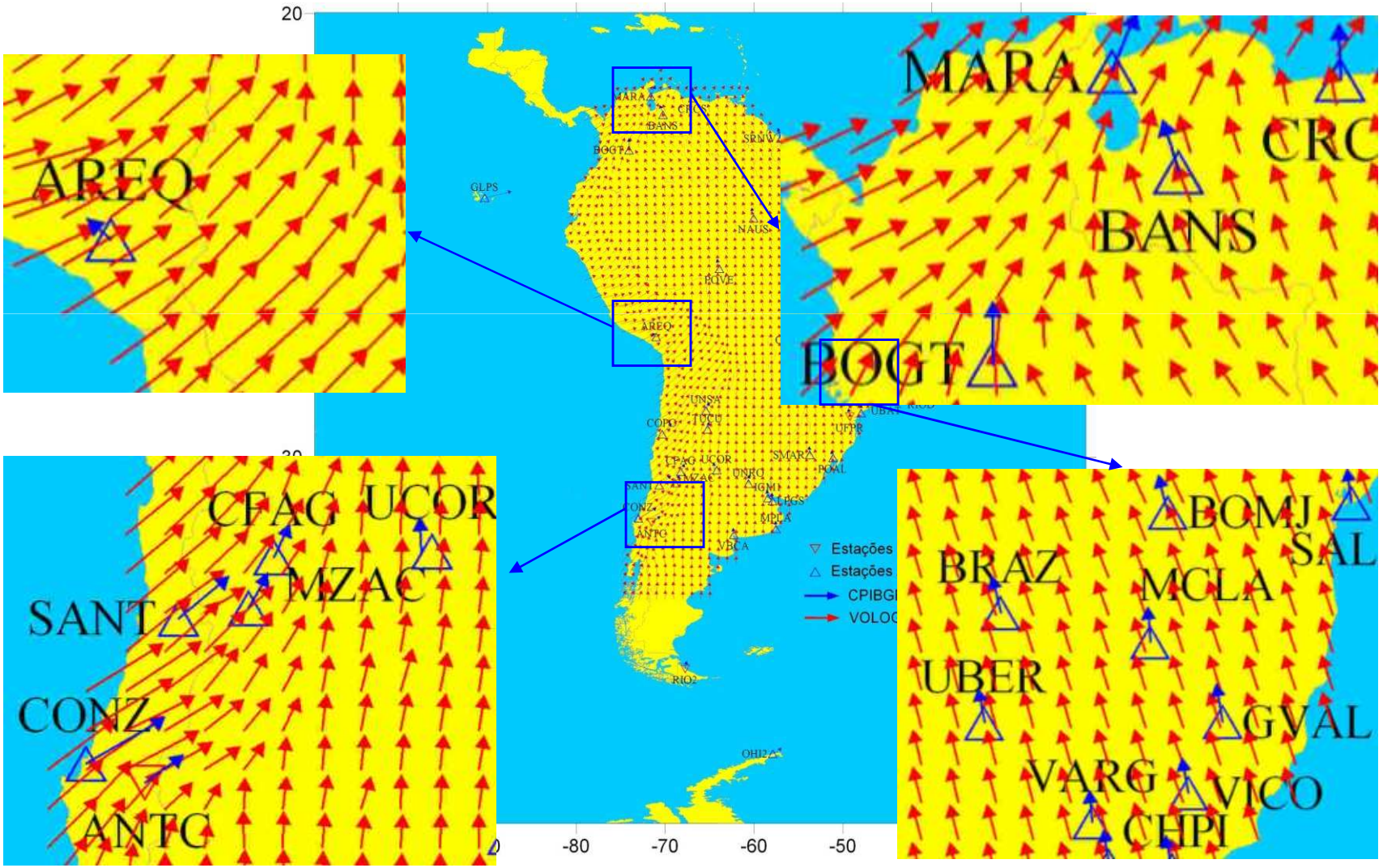
SANT





Estimated Velocities

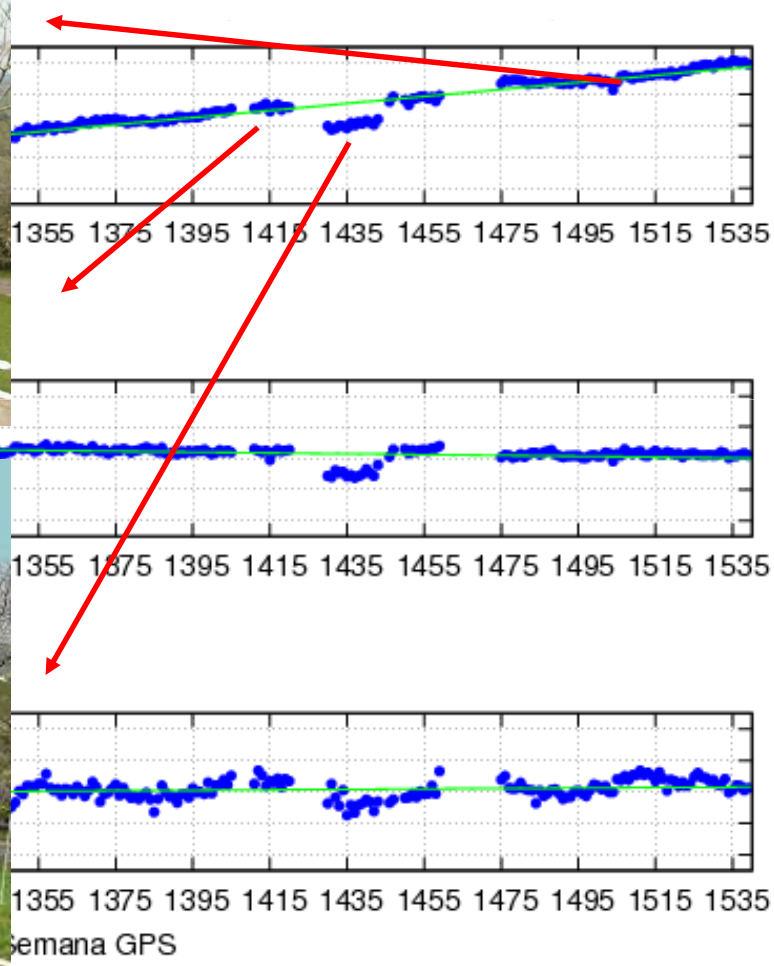
- **IBGE X VEMOS:**



What is our interest ?

- **Seasonal movements;**
- **Local behavior (monument stability);**
- **Discontinuities or jumps in the coordinates time series;**

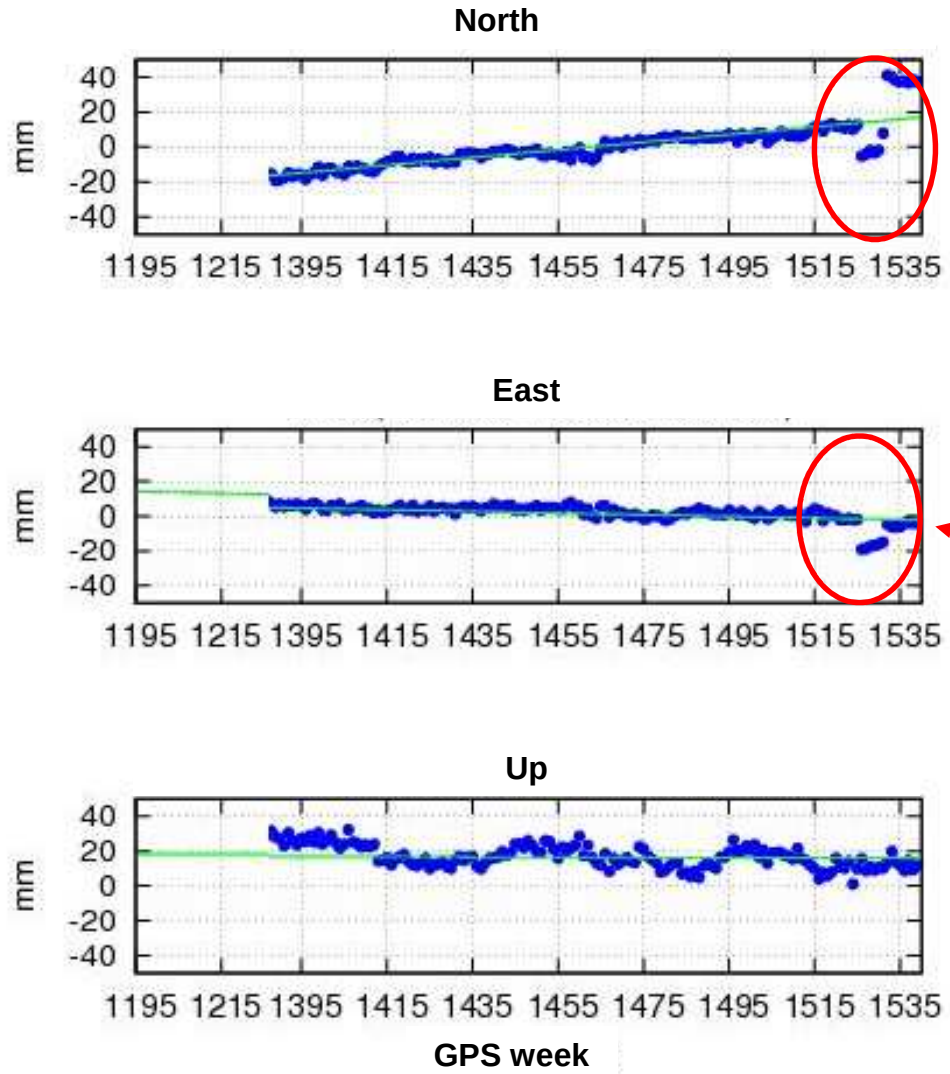
Time Series – station POAL



Horizontal difference before and after antenna change = 1,7 cm

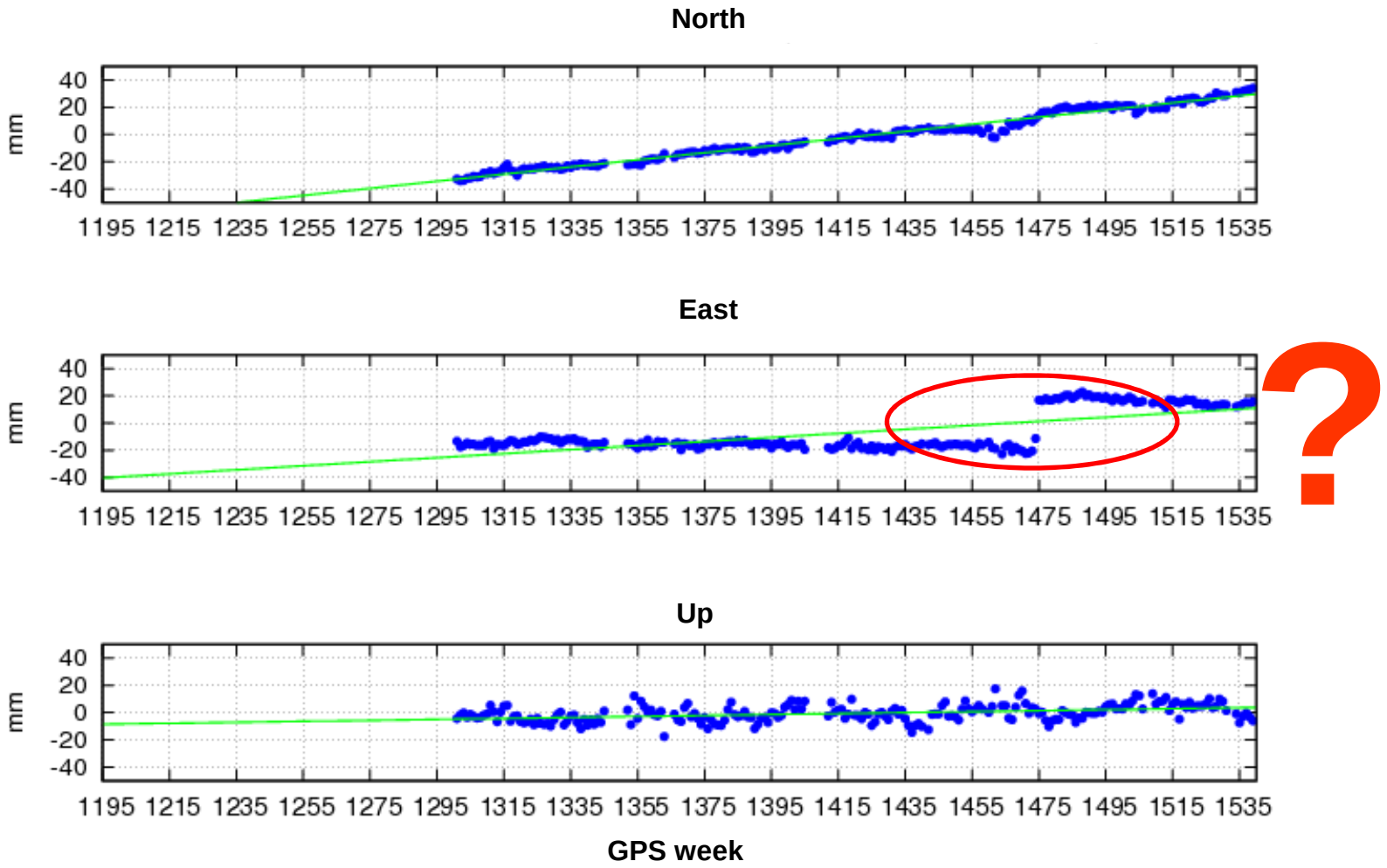
Time Series – station VARG

Horizontal difference
First jump ~ 2,5 cm
Second jump ~ 4,4 cm

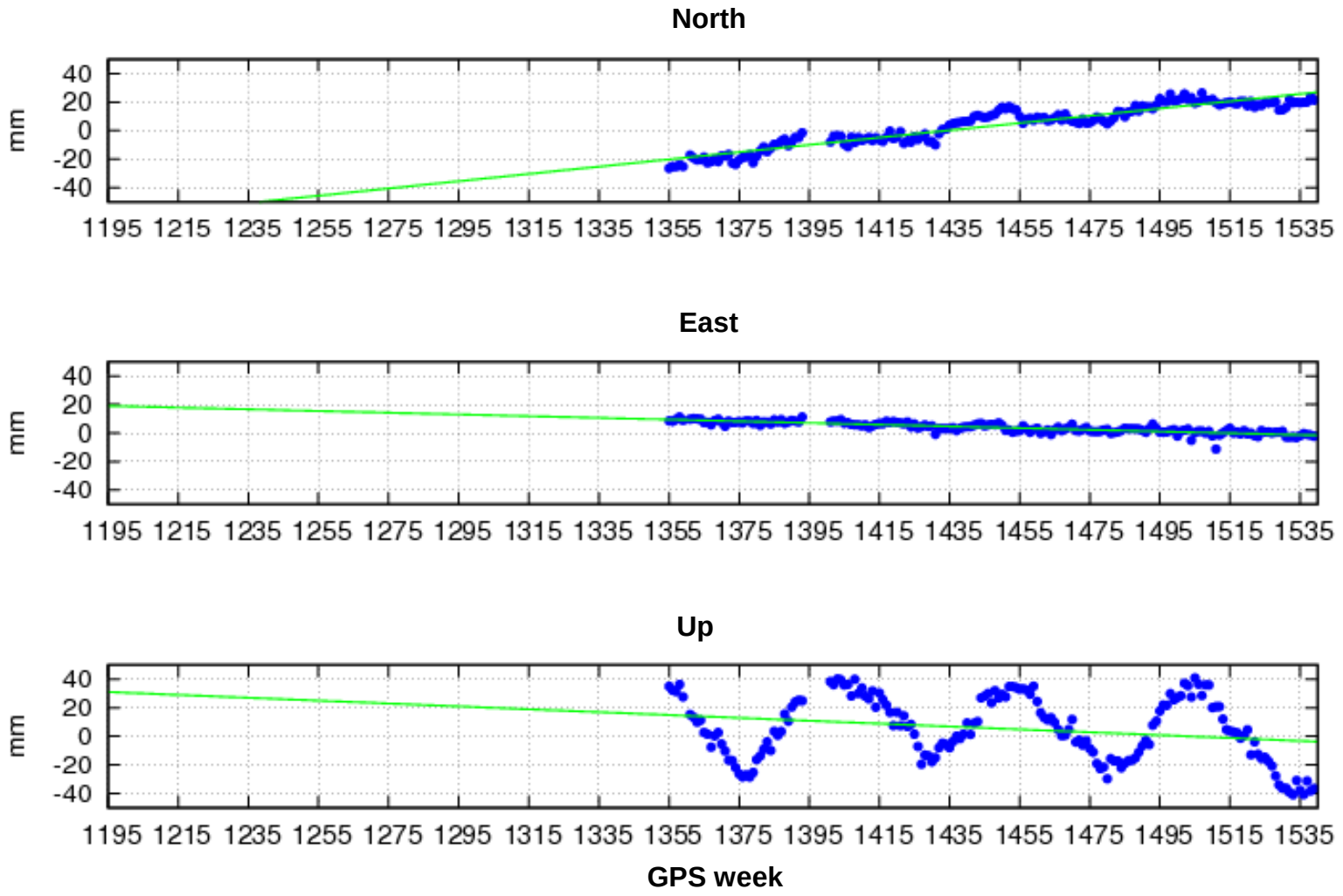


Time Series – station UBAT

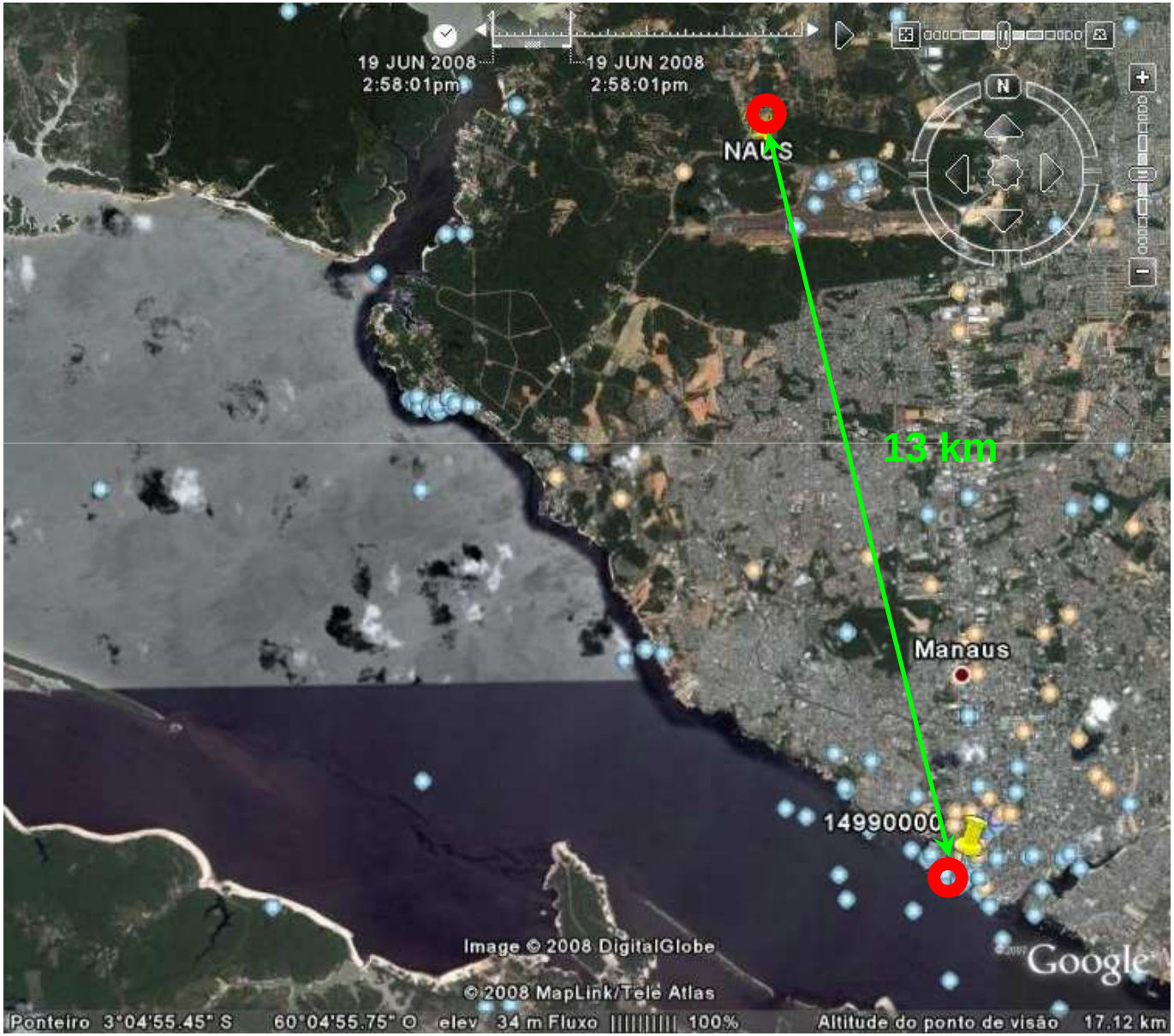
Horizontal difference
First jump ~ 4 cm



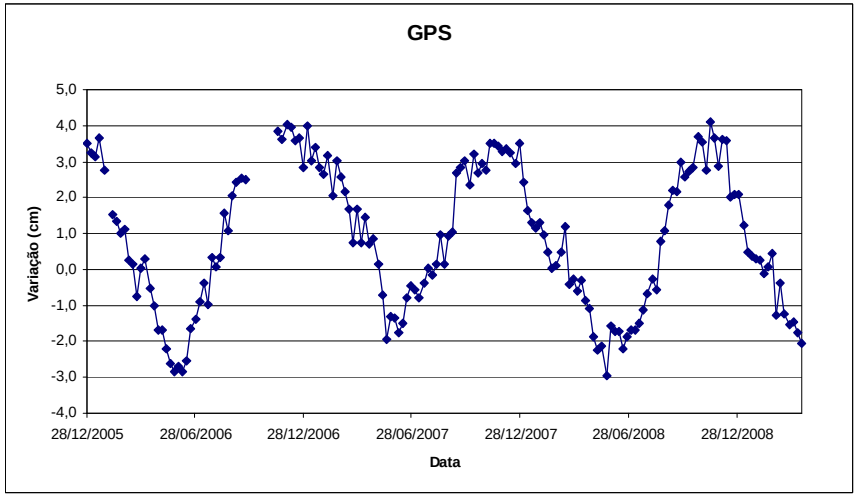
Time Series – station NAUS

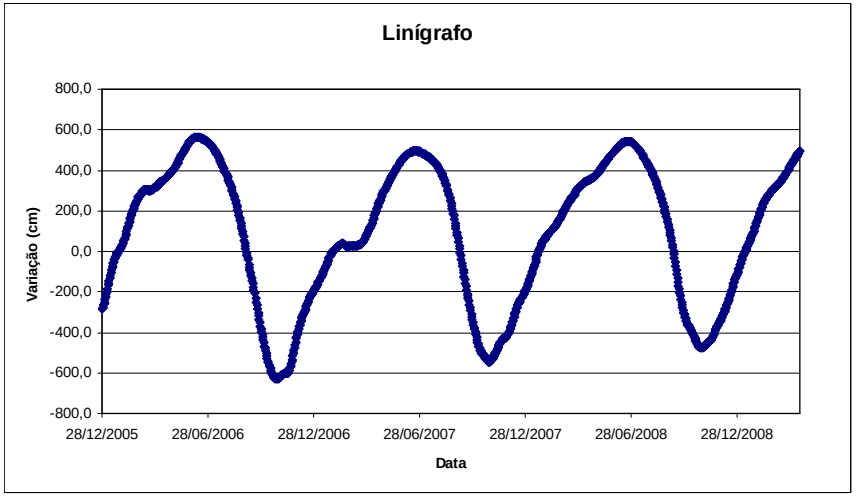


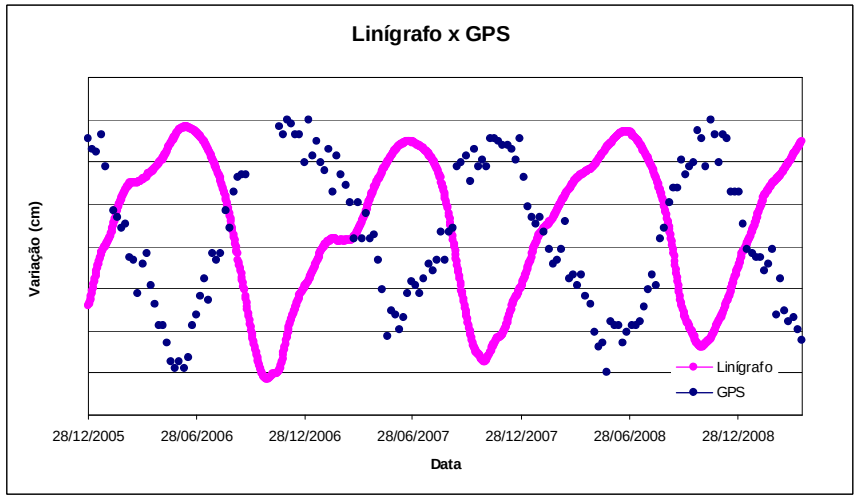
Distance between two stations



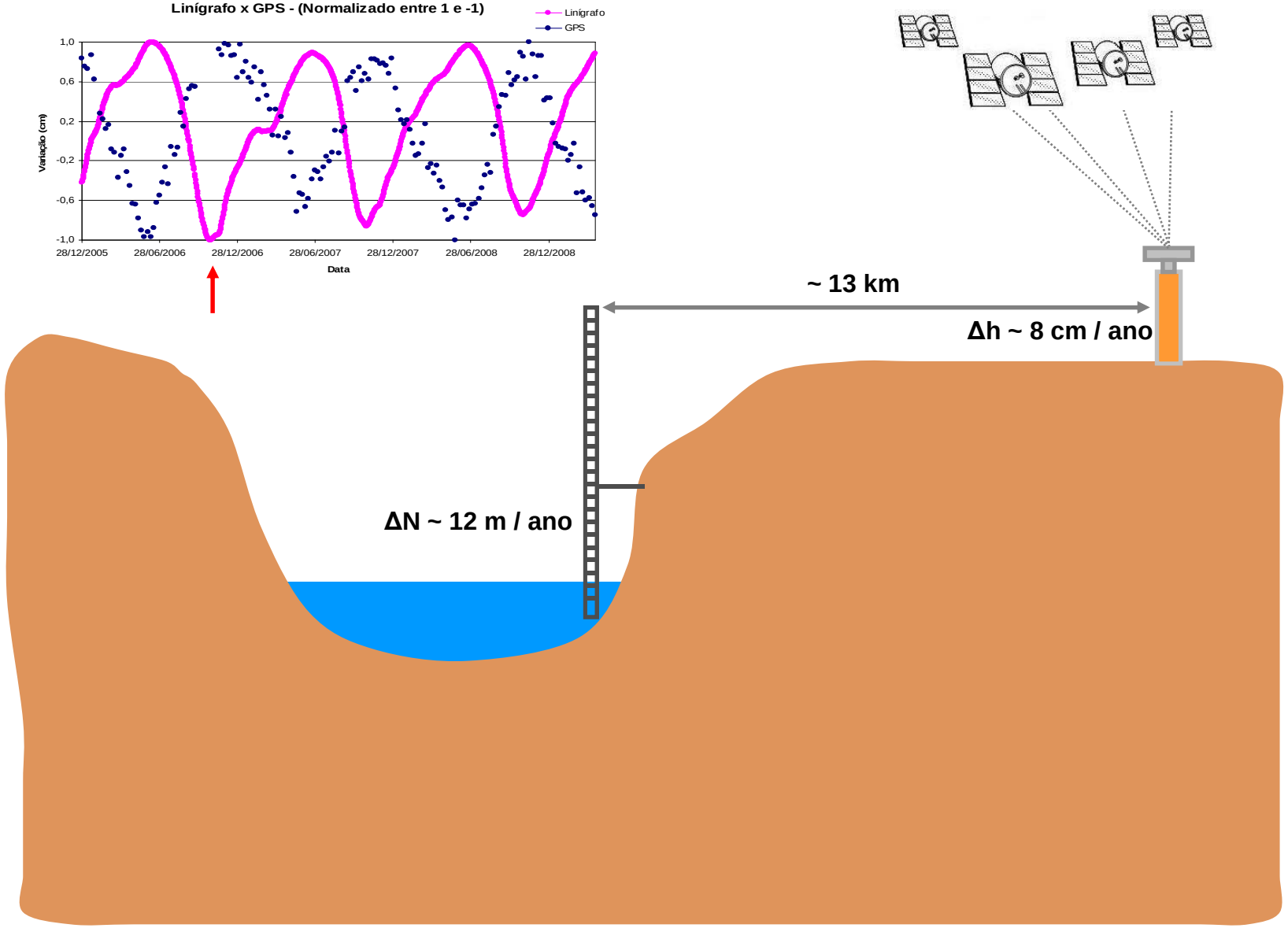
Time Series – NAUS x hydrometric station



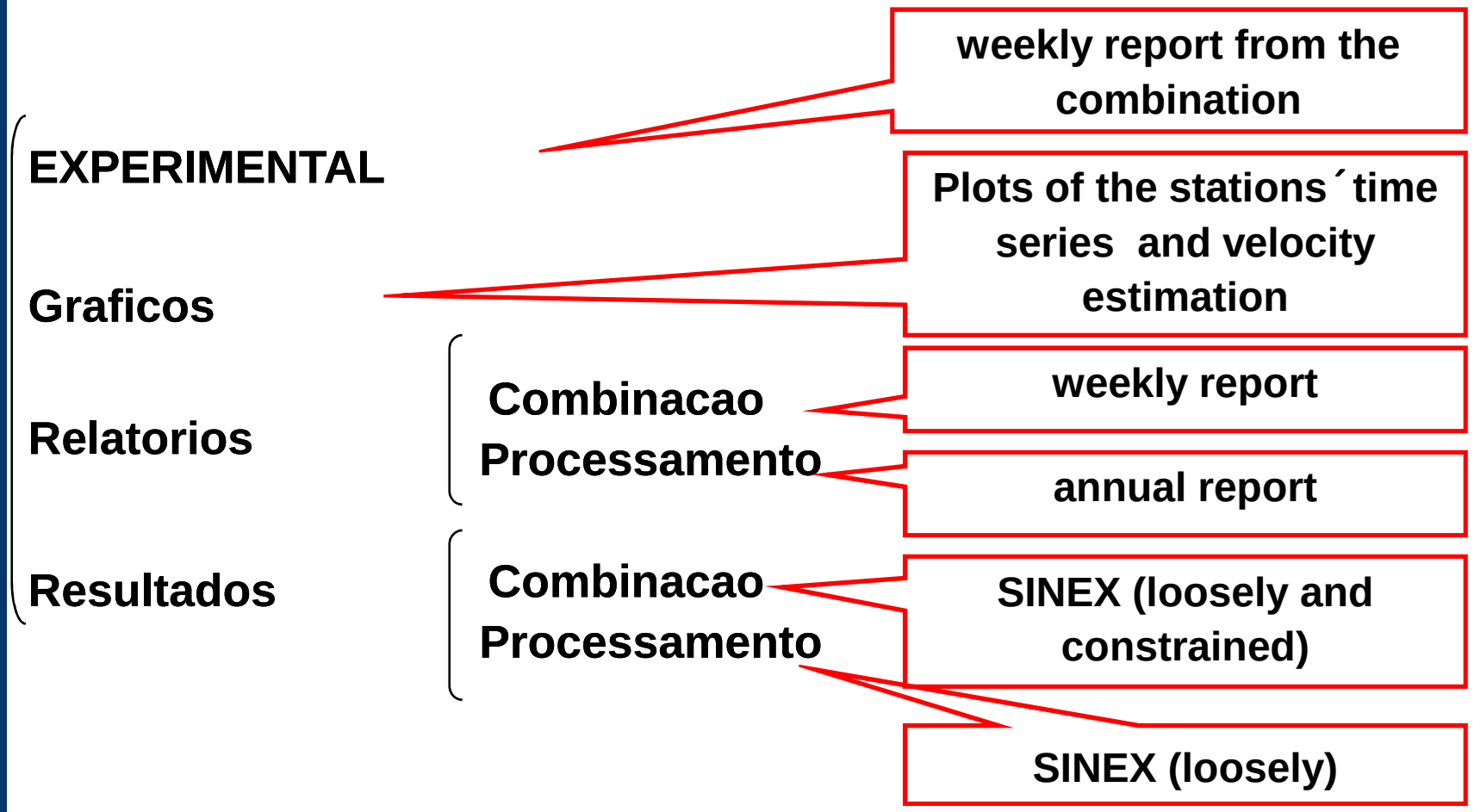




Time Series – NAUS x hydrometric station



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



Summary

- ✓ GPS processing is essential for the reference frame control and maintenance;
- ✓ Results are consistent with the other processing centers;
- ✓ The velocity vectors and the temporal behavior of each station will be better defined and reliable, due to the increasing number of processed weeks

Future Work

- ✓ New processing strategy (ambiguities resolution)
- ✓ website;

IBGE
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SIRGAS

Thank you for your attention!

For more information: ibge@ibge.gov.br

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