Instituto Brasileiro de Geografia e Estatística

RBMC: The main geodetic infrastructure contributing for land reform and weather researches in Brazil

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Workshop on the Applications of Global Navigation Satellite Systems
United Nations Office for Outer Space Affairs

Trieste, 01-05 december 2014

Overview

- ✓Introduction
- ✓Current status of RBMC
- ✓real-time service – RBMC-IP
- ✓Regional and Global Integration
- ✓Geodynamics: Time series of vertical component
- ✓Land Reform
- ✓EMBRACE – TEC maps
- ✓CPTEC – Zenith Tropospheric Delay
- ✓Final Remarks

Introduction

✓Brazilian Network for Continuous Monitoring of GNSS

(Rede Brasileira de Monitoramento Contínuo dos Sistemas GNSS – RBMC)

- ✓ 18 years in operation ;
- ✓ Main geodetic framework in Brazil;
- ✓ Main link to global and regional reference frames;
- ✓ SIRGAS2000 is realized in Brazil mainly through its stations.

✓Stations have double frequency receivers;

✓112 in operation for post-mission applications;

- ✓ 88 in real-time NTRIP **- RBMC-IP**;
- ✓ 31 Meteorological Equipments

✓monthly downloads ~ 400000;

Current Status

Open access to data from IBGE and INCRA websites;

ftp://geoftp.ibge.gov.br/RBMC/ (daily files / 15 sec)

http://ribac.incra.gov.br/ (1 hour files / 5 sec)

✓Cooperation with more than 40 brazilian institutions+INCRA +INPE;

✓**Recent activities:** receiver change to GNSS;

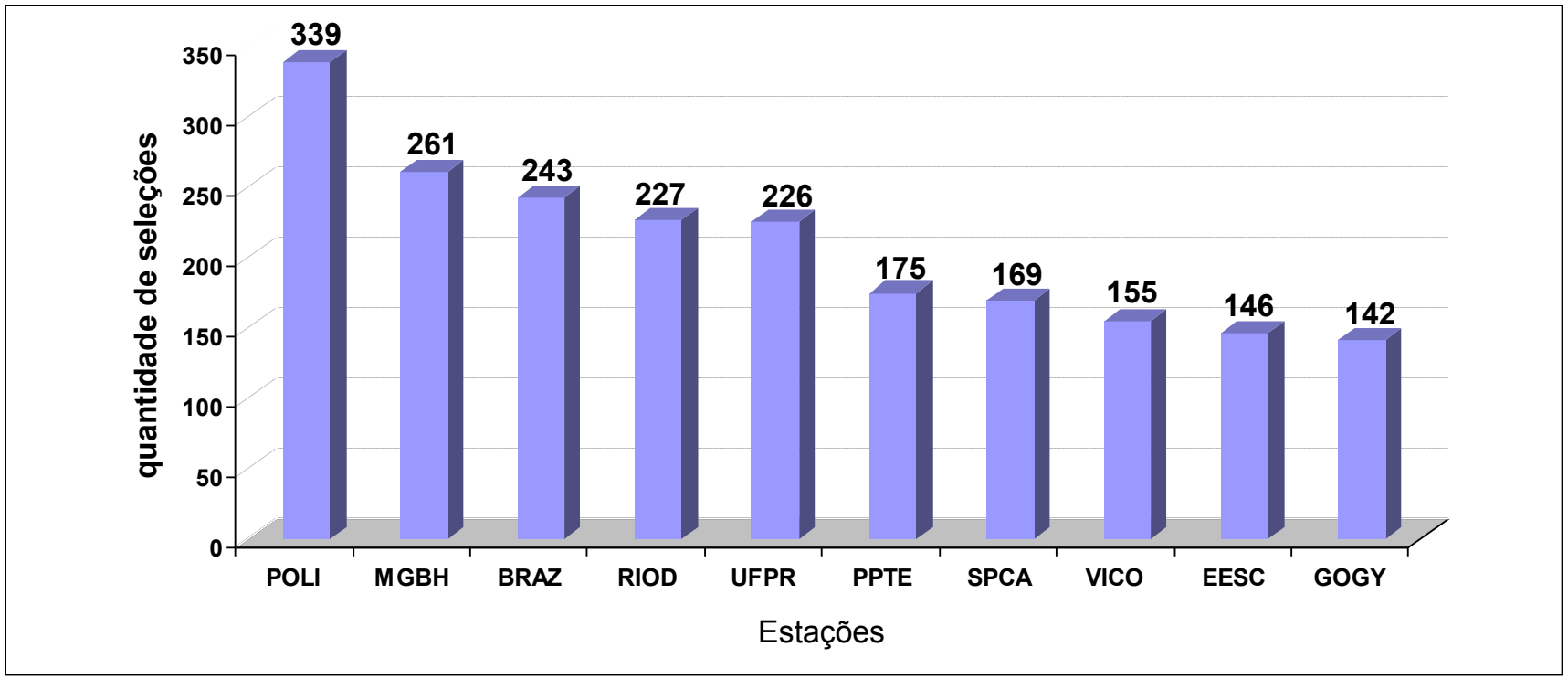
meteorological instruments;

✓**Practical applications:** georeferencing , rural and urban cadastre, positioning and navigation.

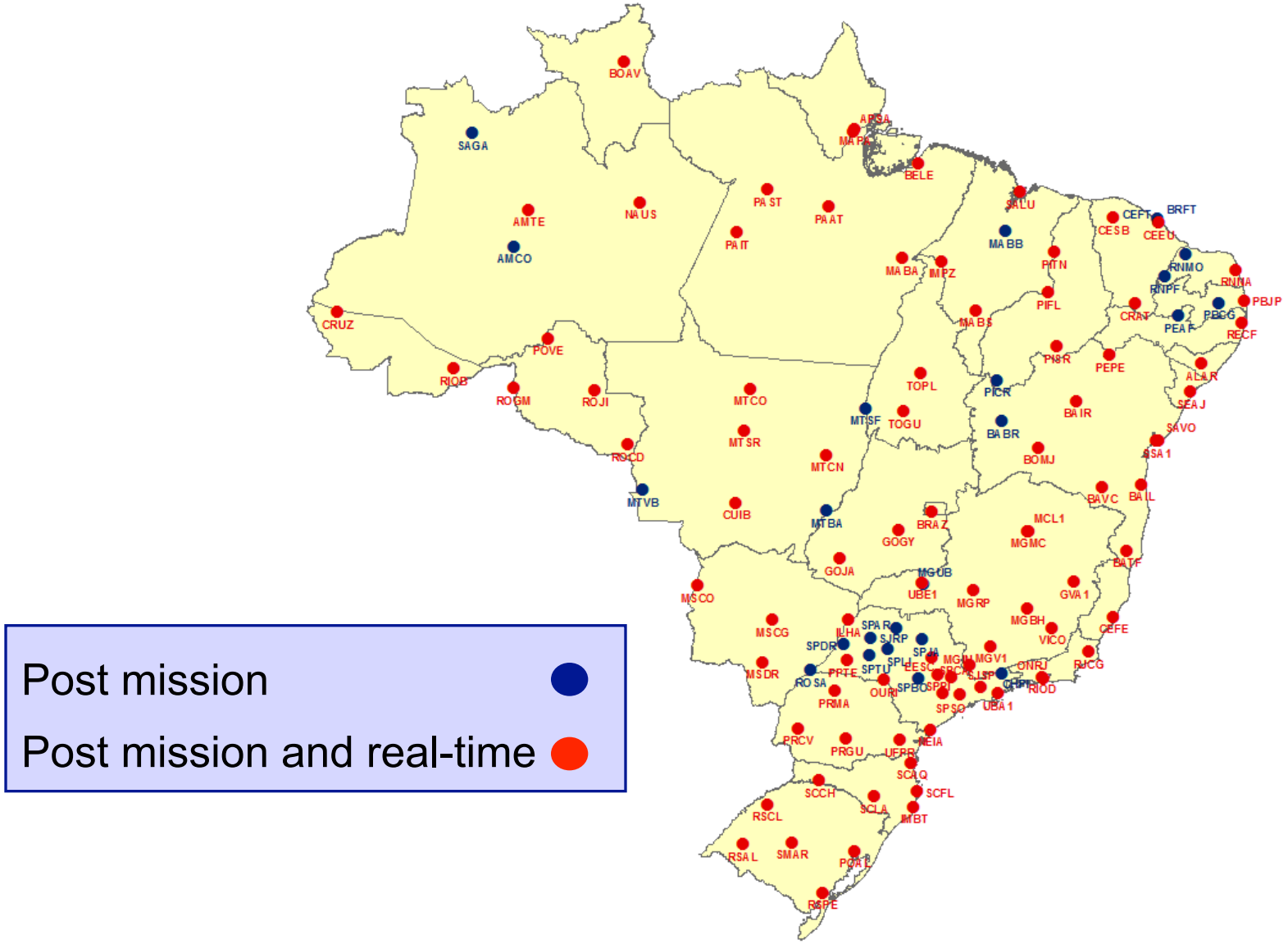
✓**Scientific applications:** ionosphere and troposphere modelling, numerical weather prediction and geodynamics.

Real time service – RBMC-IP

- ✓ Limited access : 5 stations per user
- ✓ Open access for research
- ✓ NtripCaster receives real-time orbits and clock corrections from IGS-RT



RBMC Status - nov 2114



Post mission

Post mission and real-time

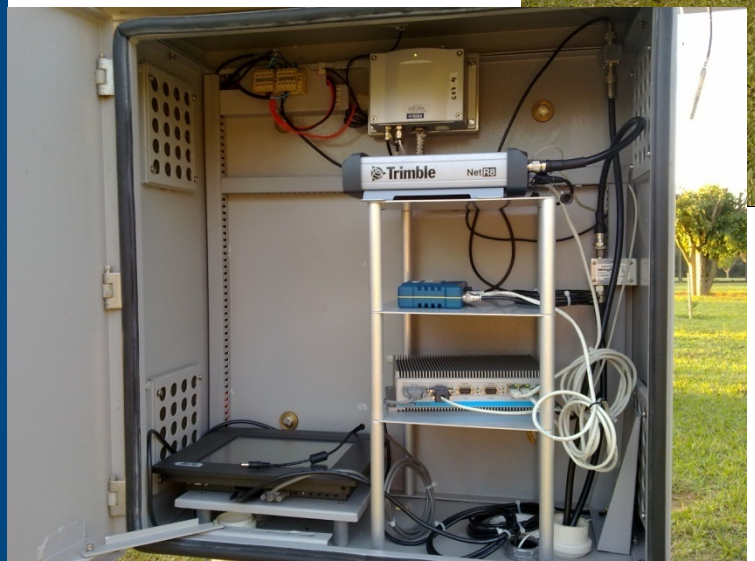
RBMC – Meteorological data (31 stations)

Vaissala PTU 300

Data Collection : 1 min
Temperature
Pression
Humidity

RBMC Station NAUS - Manaus (Amazon Region)

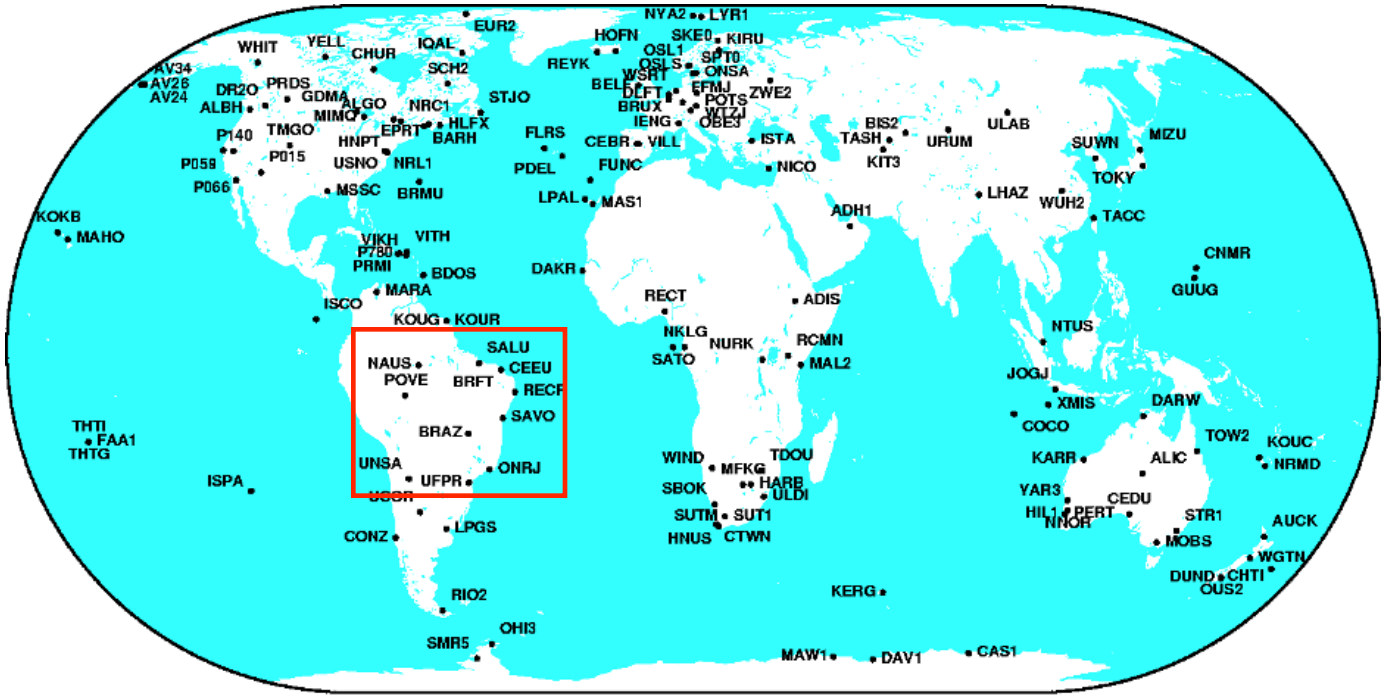
RBMC Station – SJSP (São José dos Campos)



Regional and Global Integration

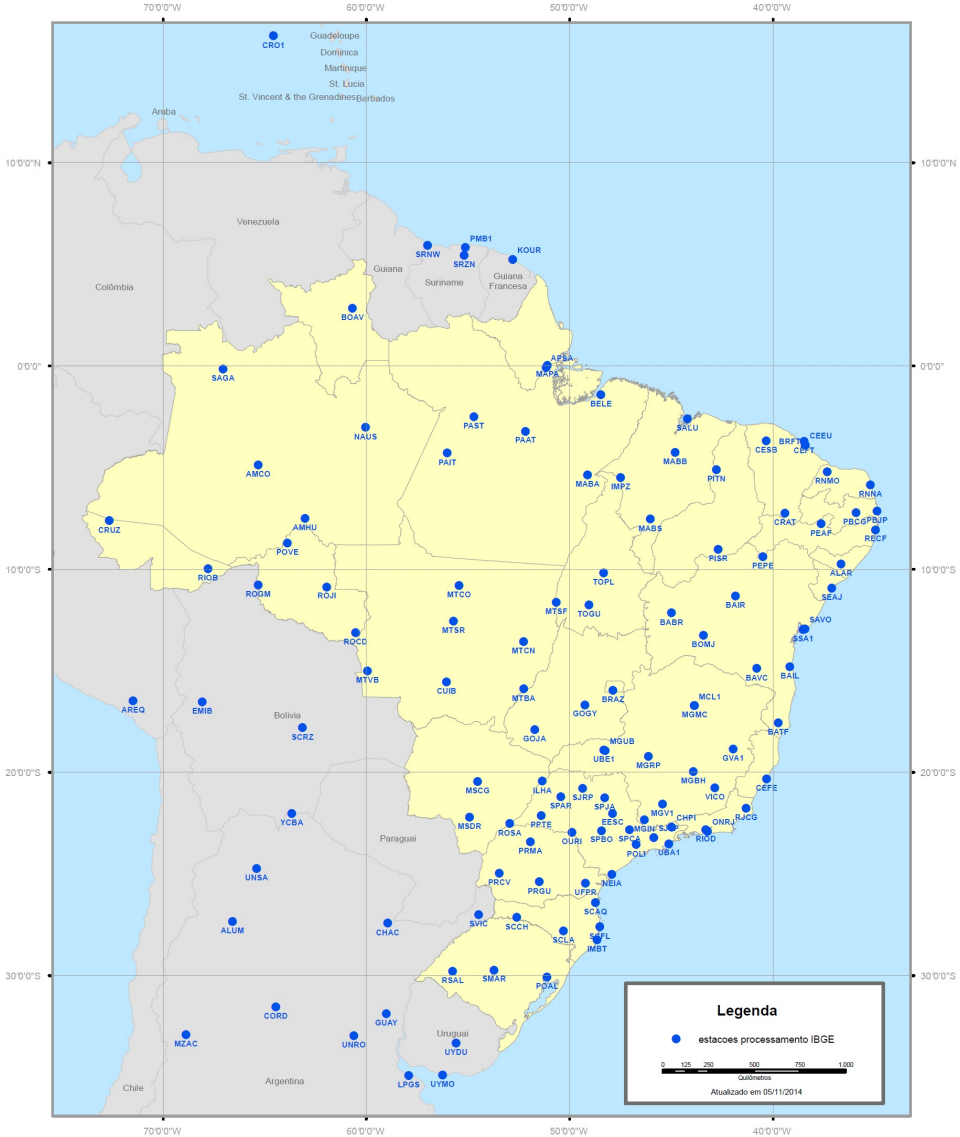
- ✓ All stations belong to SIRGAS-CON network

  (IGS densification network in Latin America and the Caribbean)
- ✓ Weekly solutions generated by IBGE and other 8 processing centers in South America
- ✓ 10 stations contribute for IGS-RT products



GMT 2013 Mar 5 15:25:24

Maintenance of Brazilian Geodetic System SIRGAS2000: SIRGAS Analysis Centre IBGE

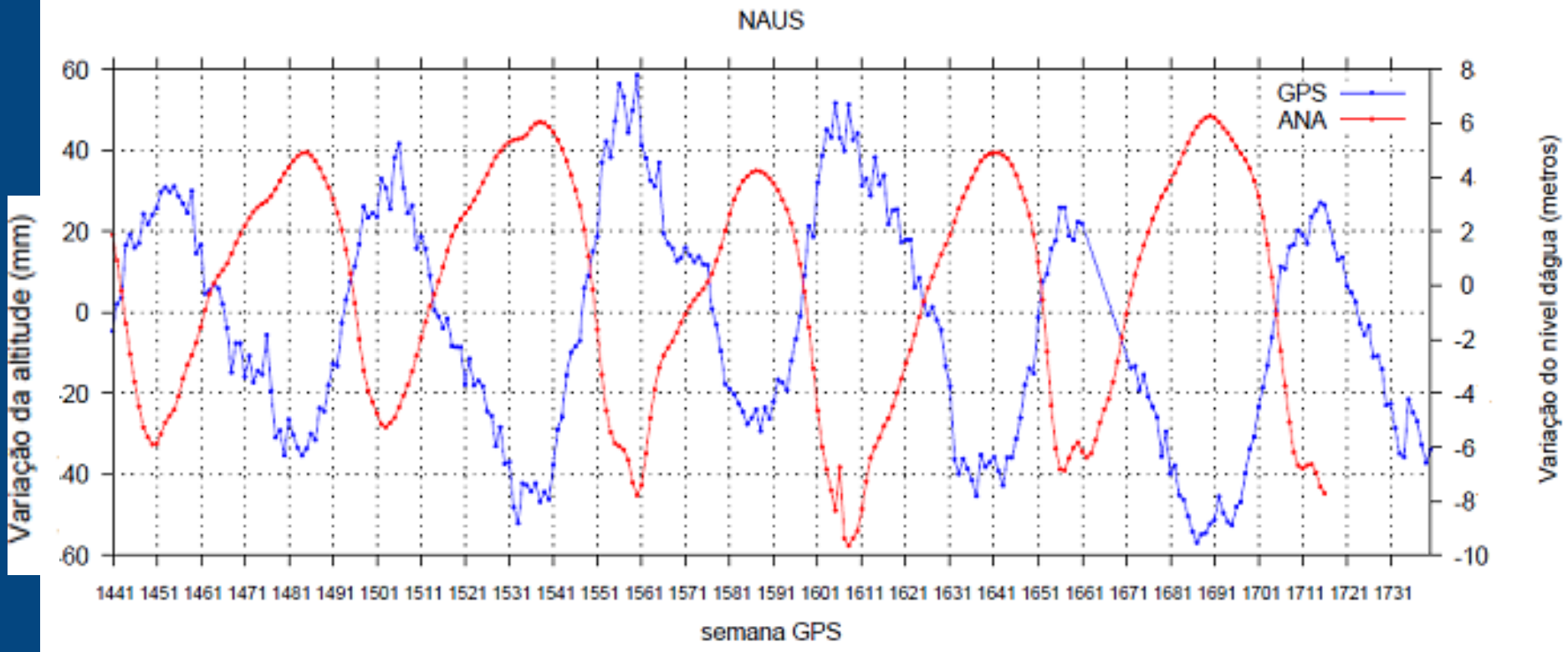


Weekly solutions from 141 stations

Station NAUS

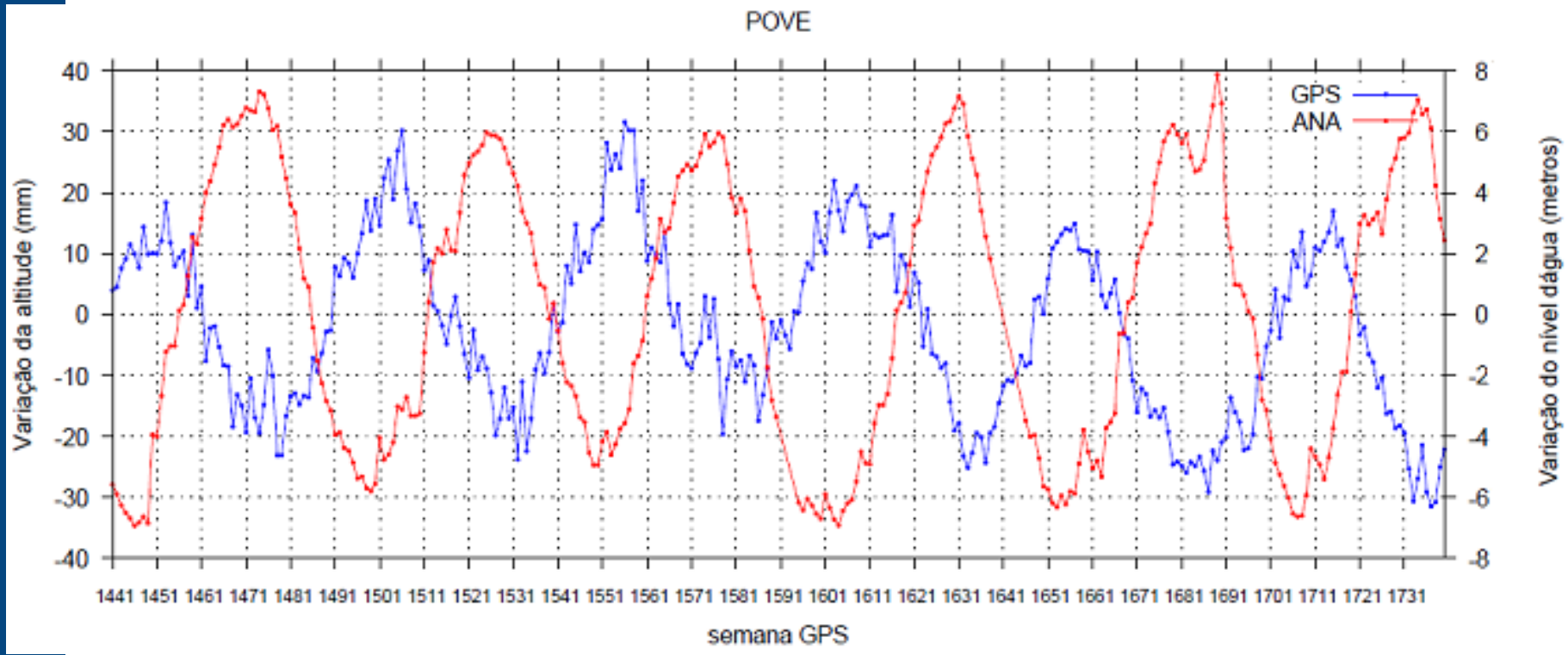
Time Series (up comp. X limnimeter)

~ 7 cm per year



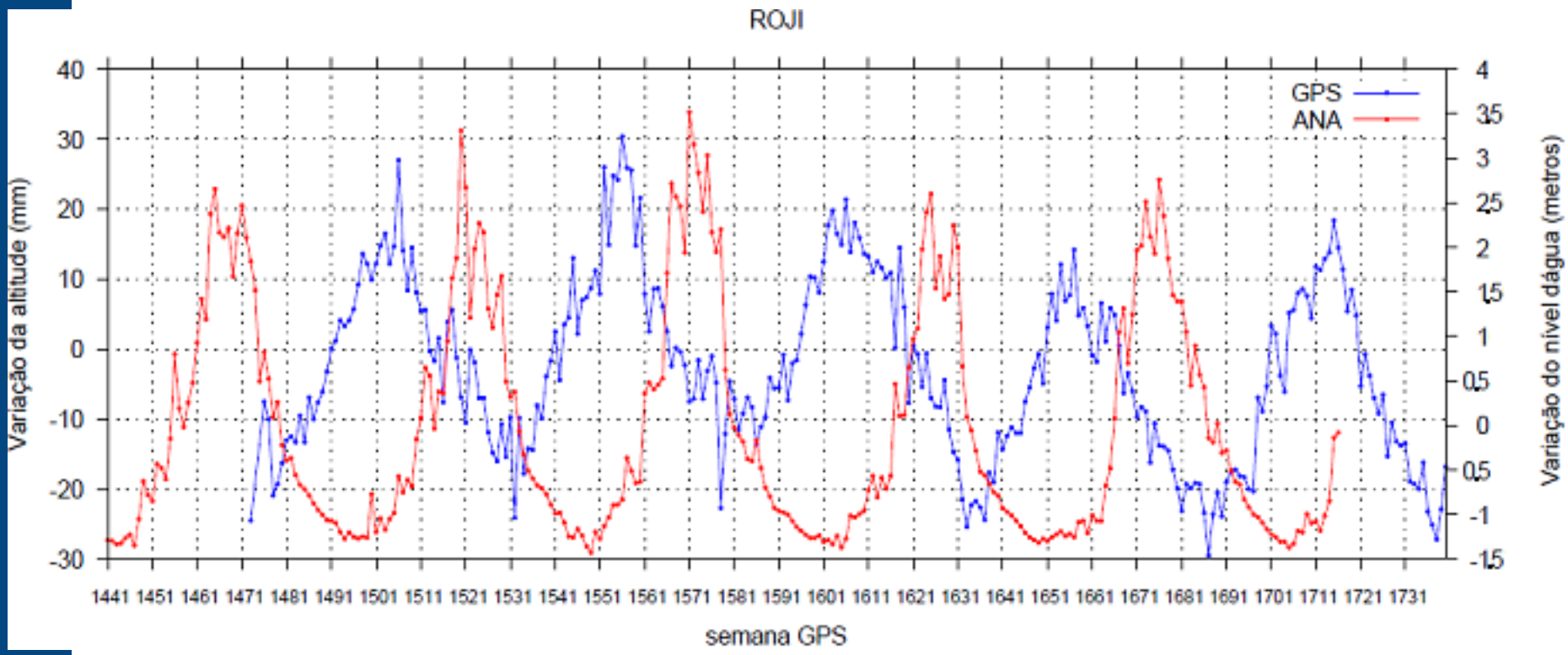
Station POVE

Time Series (up comp. X limnimeter)



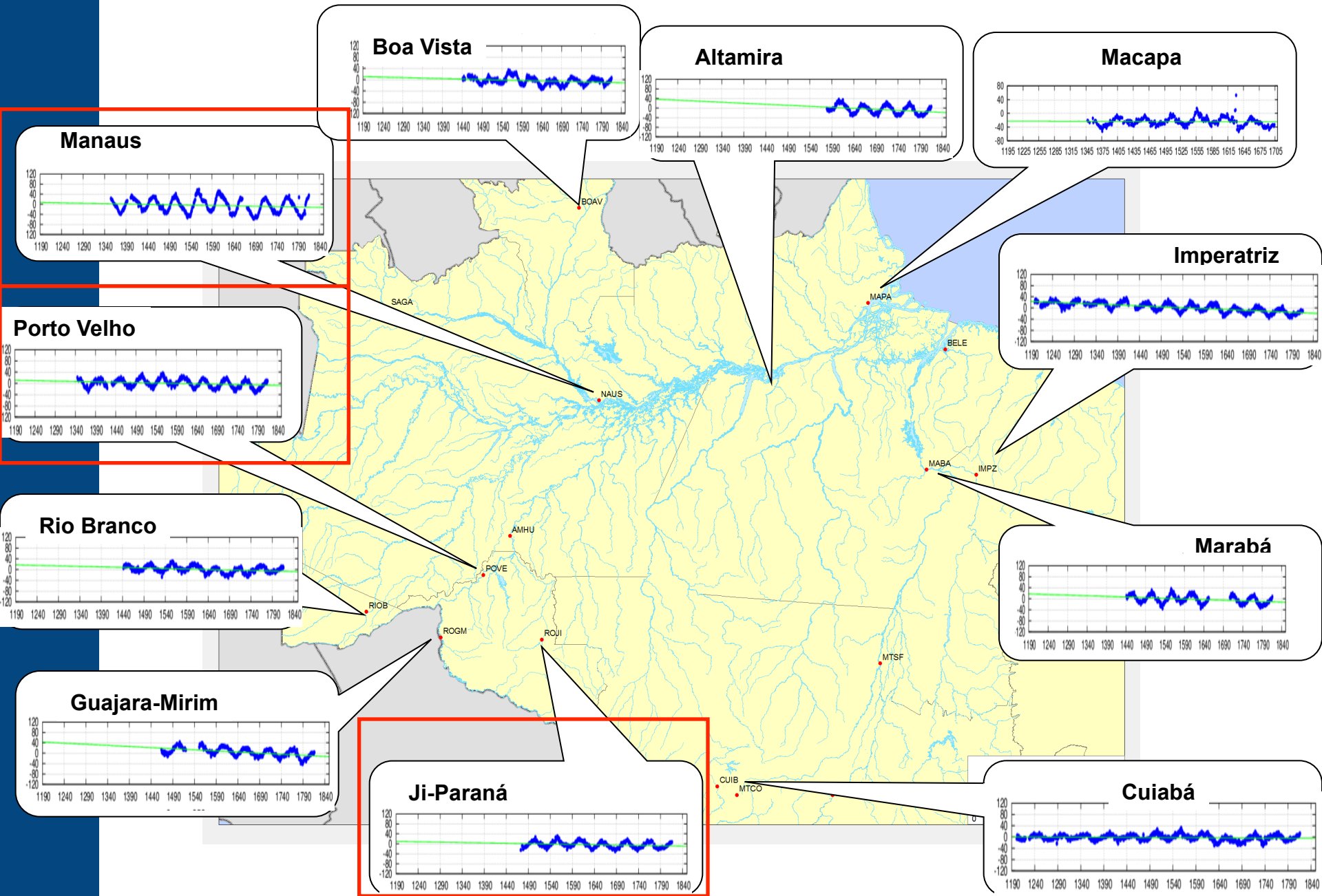
Station ROJI

Time Series (up comp. X limnimeter)



Time Series of Vertical Component

IBGE



Land Reform

Brazilian Territorial Area 8.515.767,049 km2

INCRA (Instituto Nacional de Colonização and Reforma Agrária)

responsibility: National Cadastre for Rural Properties

IBGE responsibility: Brazilian Geodetic System

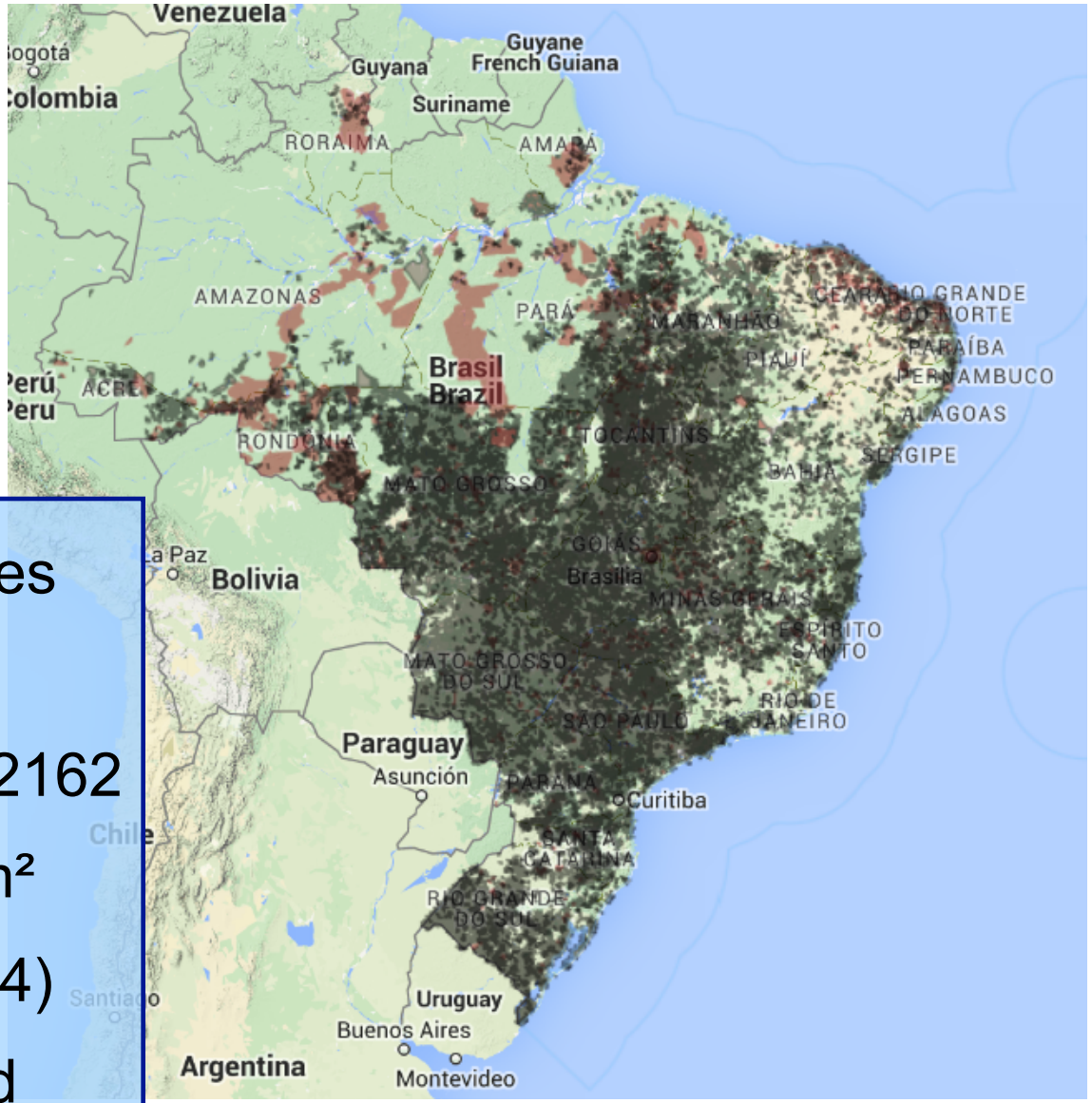
- ✓ **Law 10267/01** – Federal law that obly all owner of a rural property provide a georeferenced planta(scretch) when any prodedure related to notariat must be done.
- ✓ The georeferencing must be connected to Brazilian Geodetic System.
- ✓ **Deadline:**
  - ✓ Year 2008, properties between 500 e 1000 hectares
  - ✓ Year 2011 others properties smaller than 500 hectares.

Land Reform

SIGEF - Sistema de Gestão Fundiária (Land Management System)

Private certified

Public certified



Certified Properties

2004 to 2014

n° of properties: 132162

1.964.295,00 km²

58655(18/11/2014)

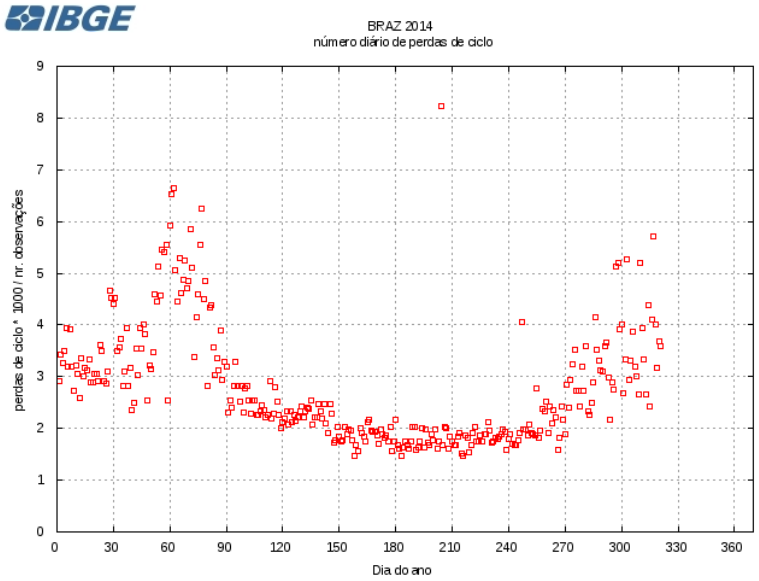
Already certified

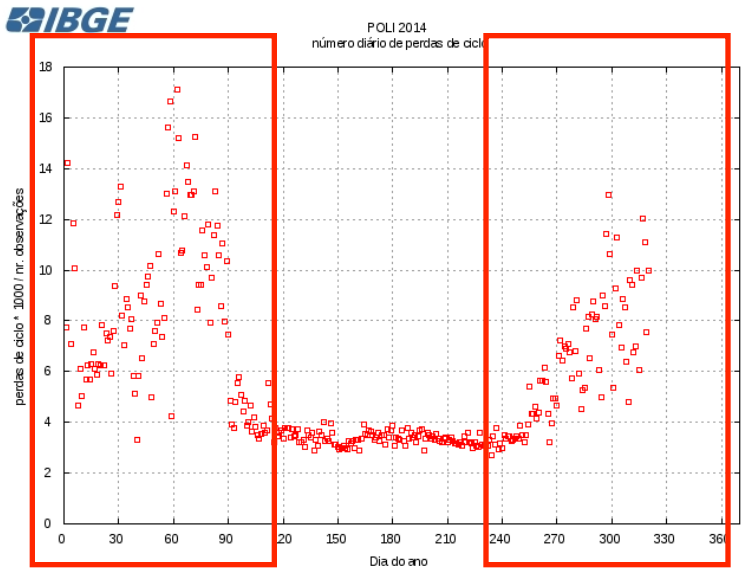
INPE - National Institute for Spatial Researches
EMBRACE - The Brazilian Space Weather Program

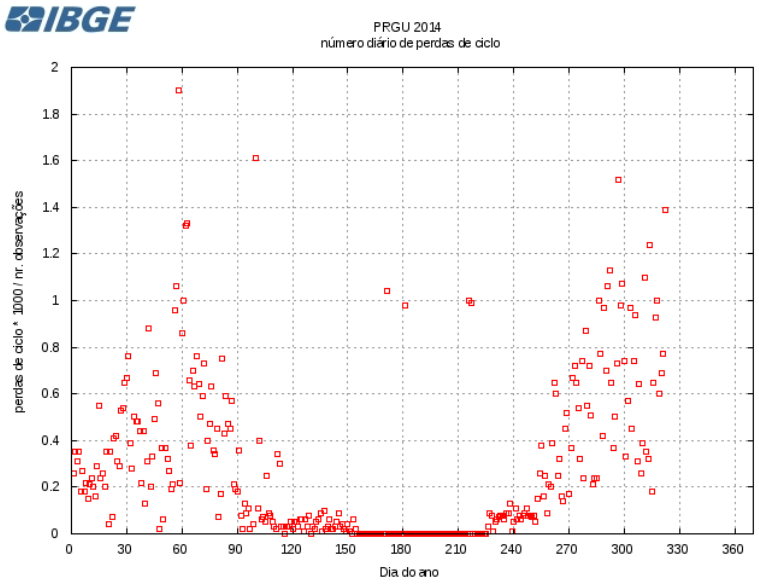
- ✓ **MISSION:** Monitor Solar-terrestrial environment , ionosphere and ground , and to predict possible influence in the tecnological and economical activities.
- ✓ Space research is concentrated in the earth's equatorial and low latitude ionospheric disturbances and plasma bubbles
- ✓ **Ionospheric disturbances :** Geographic position, season and solar activity
- ✓ **Products** : Scintillation maps(S4) and TECMAP(Total Electron Content);
- ✓ TEC Maps from GNSS ground stations (140)
- ✓ **TECMAP:** Spatial resolution: 200 to 1000 km

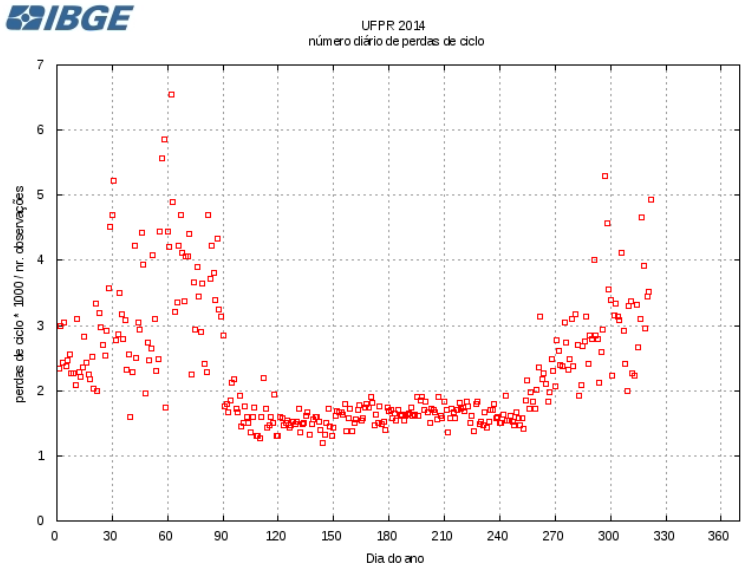
  Time window: 10 minutes (from real-time data) and 24 hours delay (post-processing data)

Disturbances in GNSS data – cicle slips



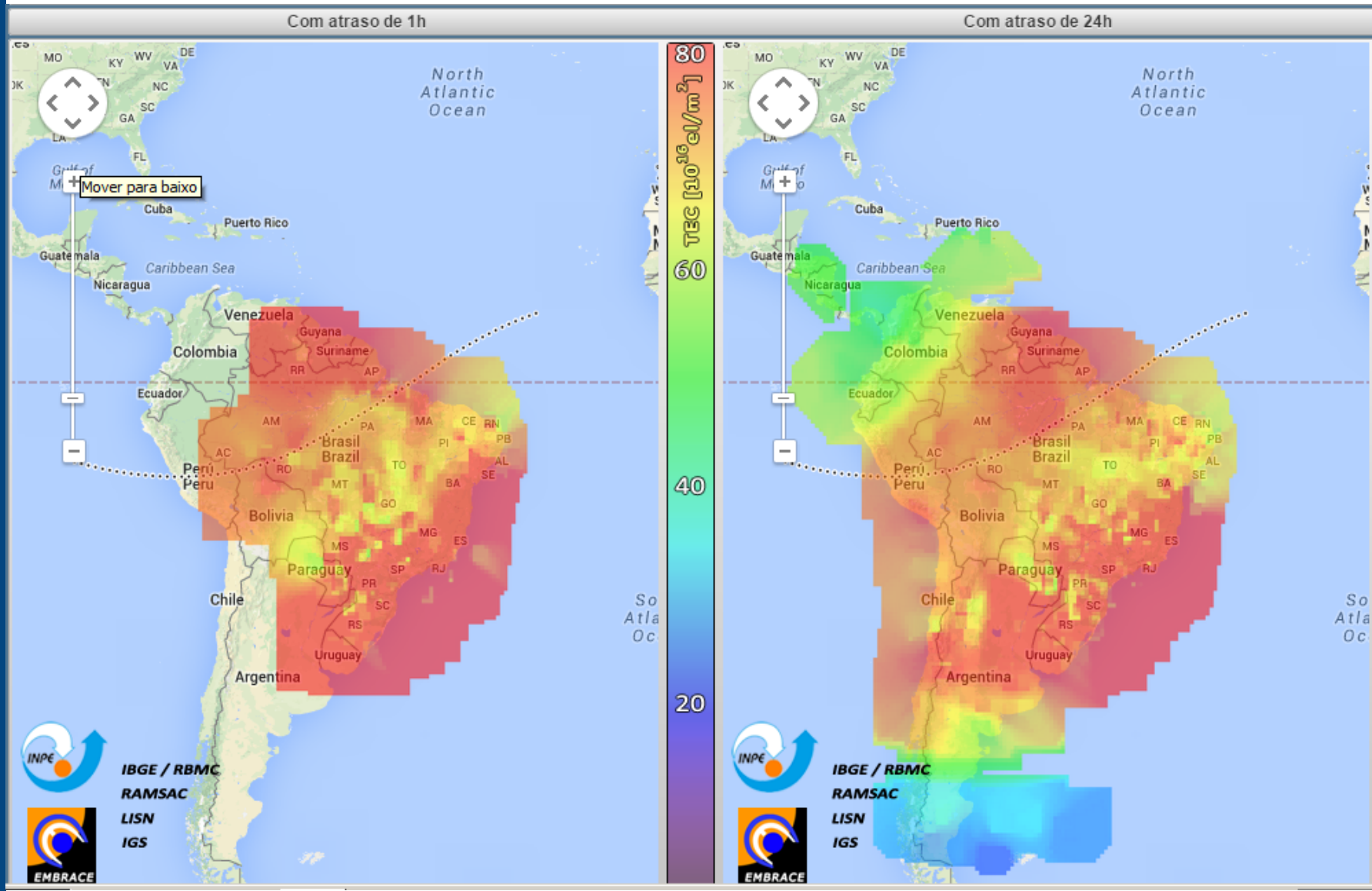




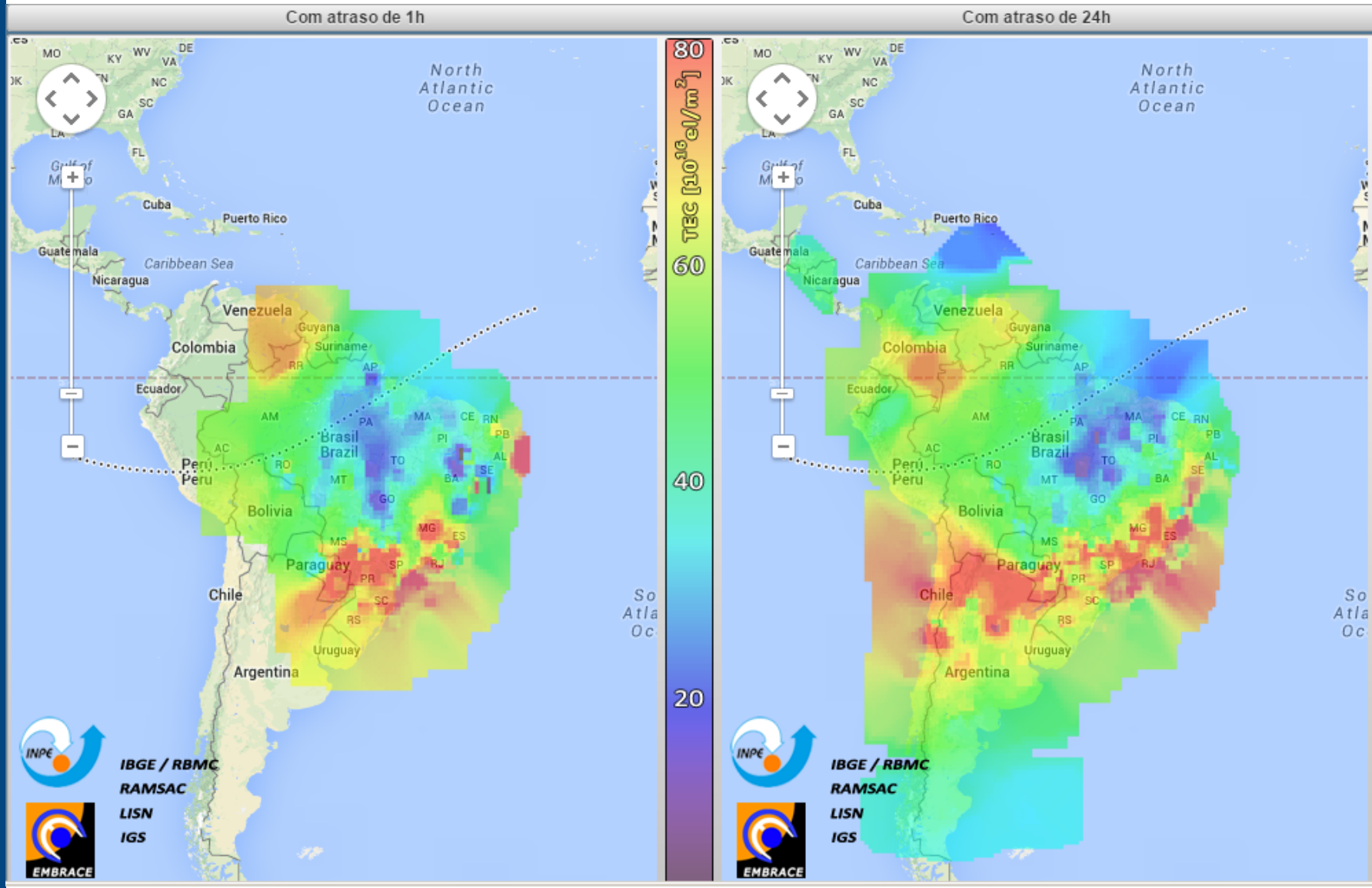


TECMAP Graphics : November 14, 2014

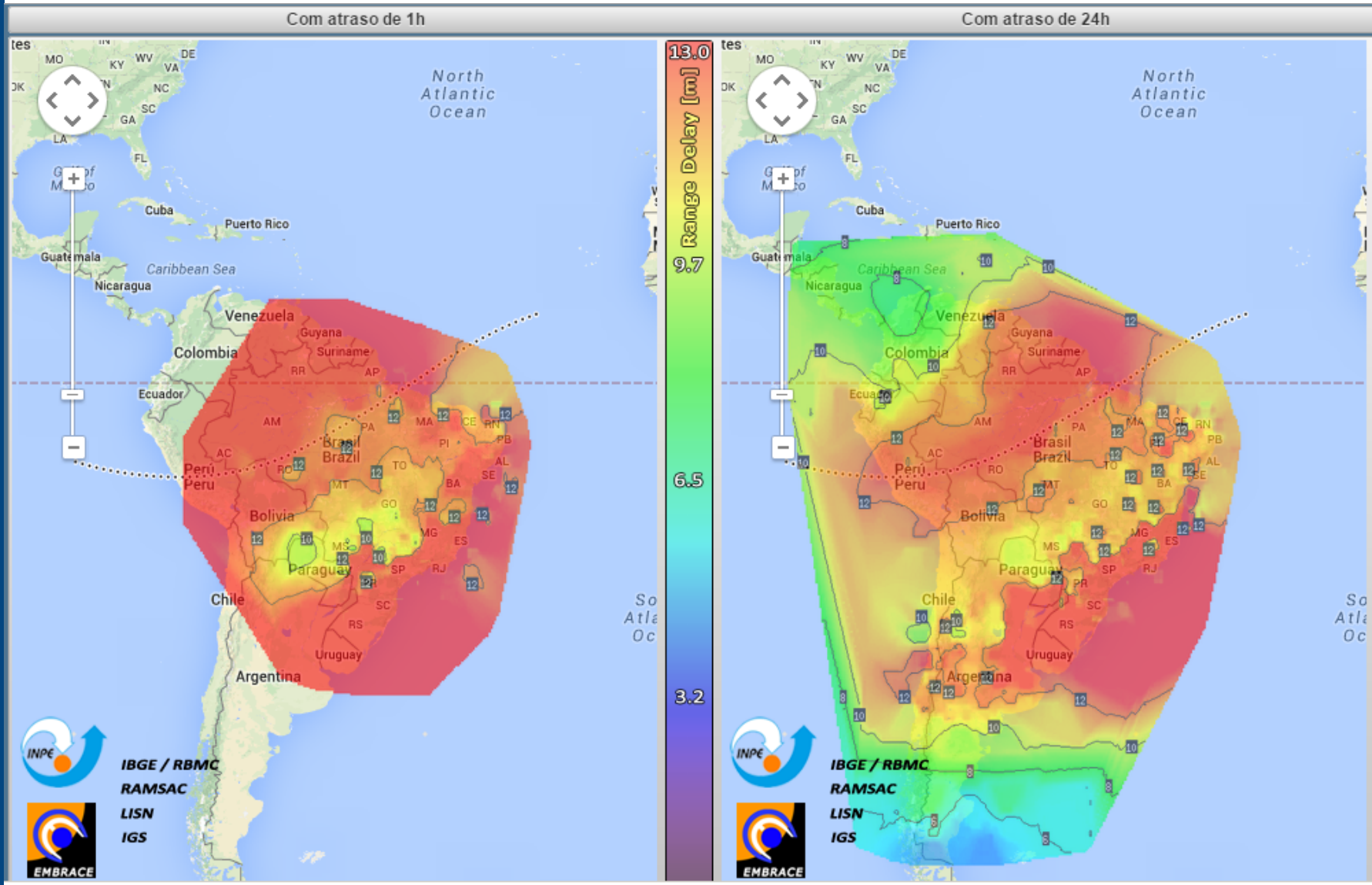
TECMAP : November 14, 2014 at 19:00 UTC
1 and 24 hours delay



TECMAP : November 14, 2014 at 23:00 UTC
1 and 24 hours delay



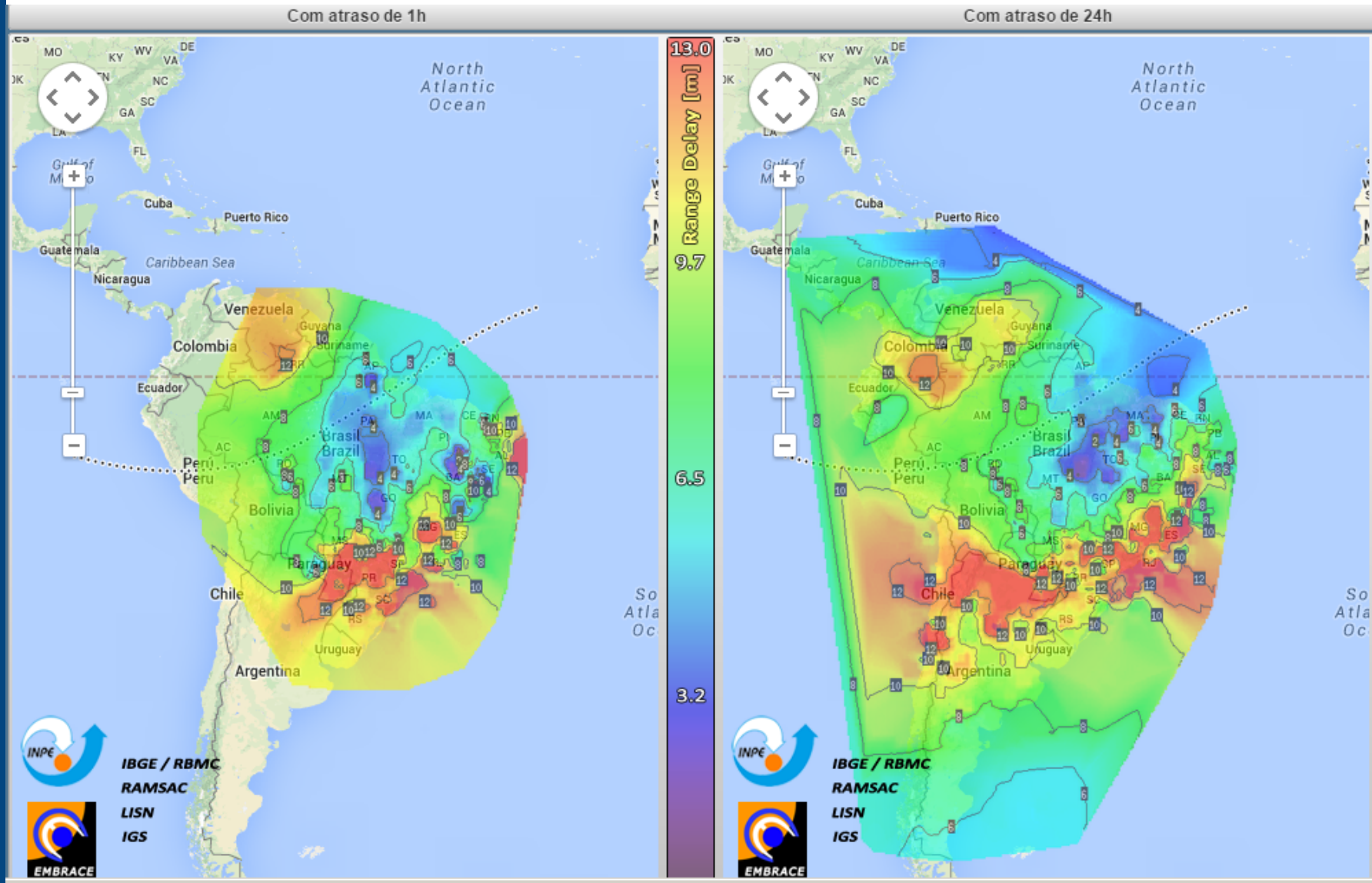
Vertical Positioning error range based on the VTEC
November 14, 2014, 19:00 UTC
1 and 24 hours delay



14/11/2014

Vertical Positioning error range based on the VTEC
November 14, 2014, 23:00 UTC
1 and 24 hours delay

01/07/2014

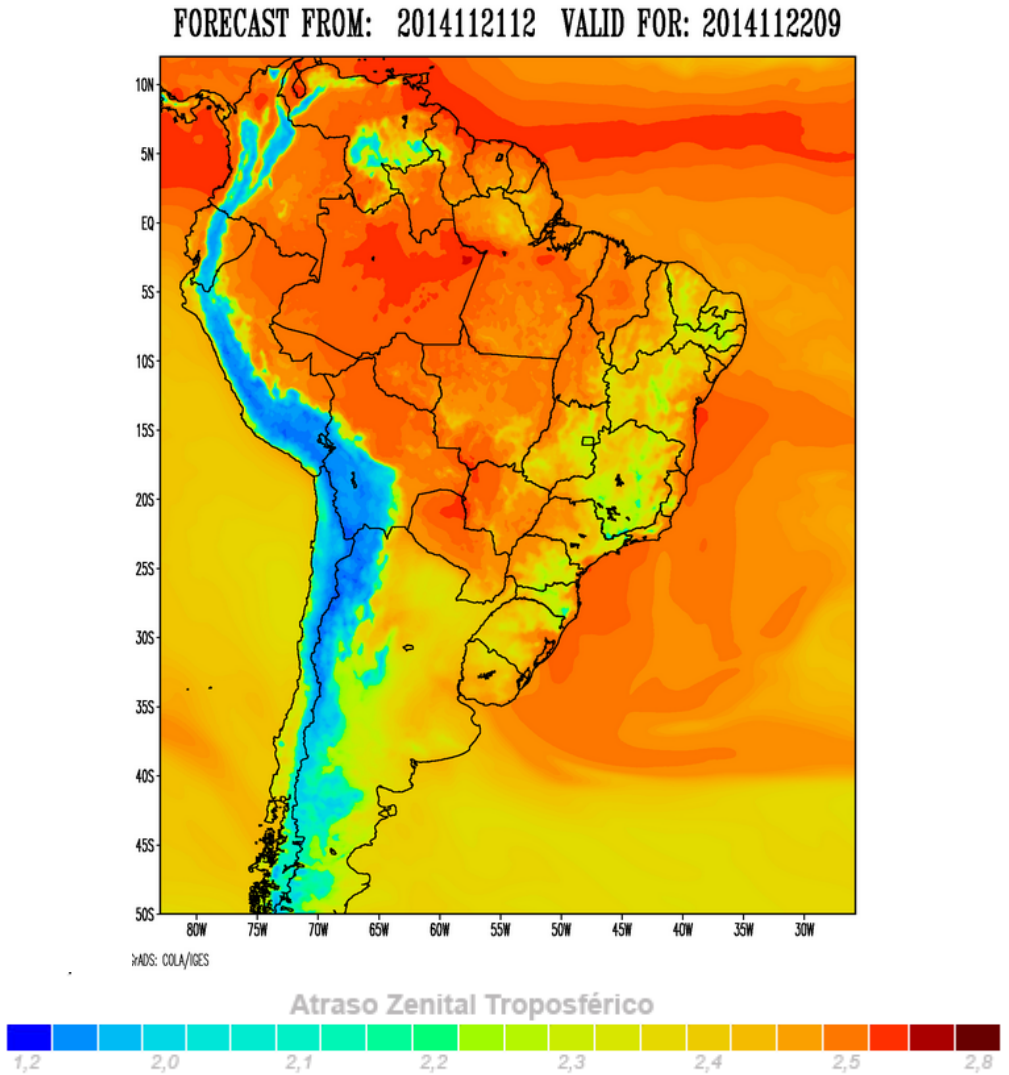


INPE - National Institute for Spatial Researches

CPTEC - Center for Weather Forecasting and Climate Researches

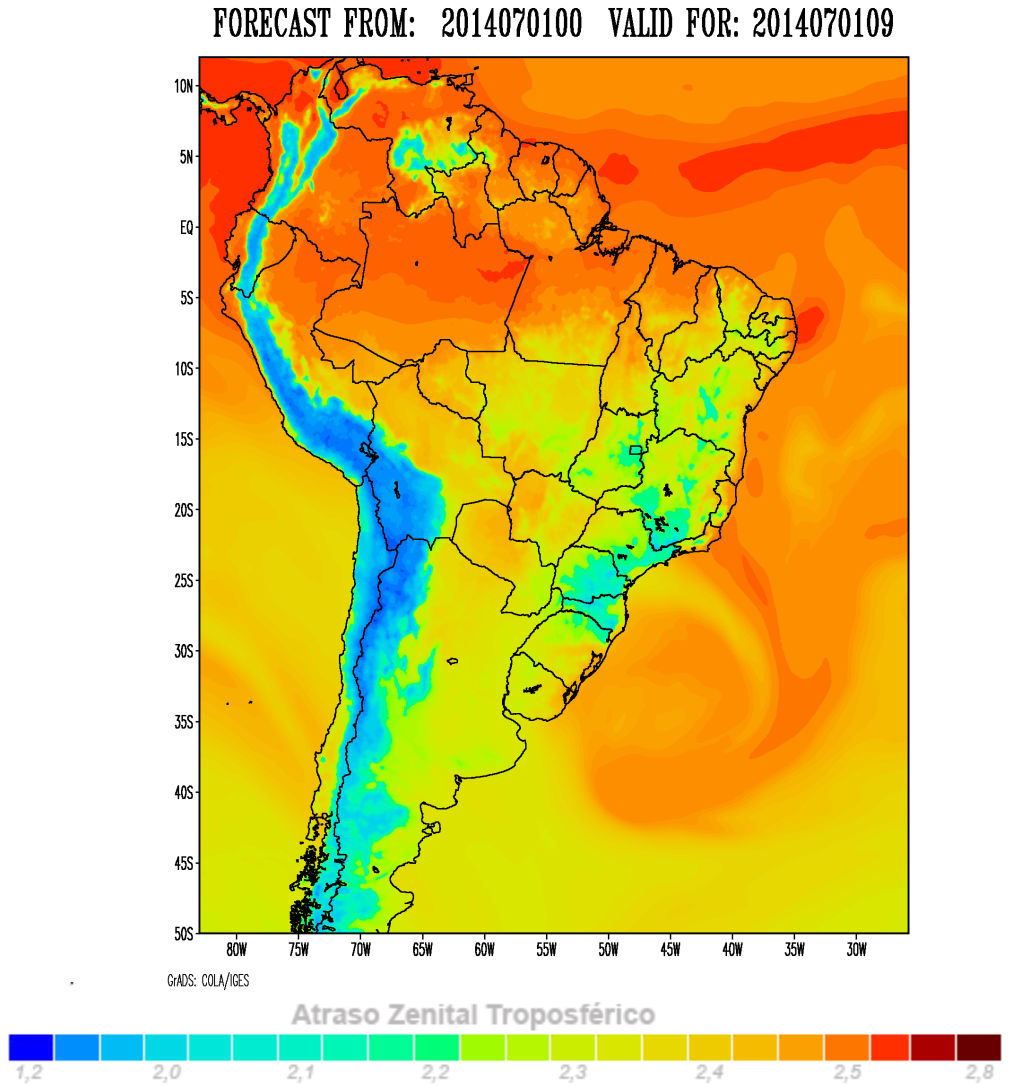
- ✓ **MISSION:** Weather forecast
- ✓ Weather and climate research using satellite and ground information
- ✓ **Tropospheric refraction :** ZenithTropospheric Delay (ZTD)
- ✓ **Products** : ZTD forecast modelling and IWV (Integrated Water Vapor)
- ✓ ZTD is estimated using NWP (Numerical Water Preciction) modeling (regional) developed by INPE
- ✓ ZTD maps are updated twice per day
- ✓ Spatial resolution: 15 km
- ✓ **Future work :** Ground data assimilation from GNSS and met data (near real time)

Predictions of Tropospheric Zenithal Delay using Numeric Weather Prediction (NWP) model : November 19, 2014



http://pyata.cptec.inpe.br/zenital/nota.jsp

Predictions of Tropospheric Zenithal Delay using Numeric Weather Prediction (NWP) model : July 1, 2014



http://pyata.cptec.inpe.br/zenital/nota.jsp

Integrated Water Vapor : August 1st, 2014, 21:35 UTC

Final Remarks

- ✓ RBMC still needs densifications in some areas, mainly in Amazon region;
- ✓ Met data assimilation is very important for humidity estimation in Amazon and convergence zones, and for the evaluation of NWP models as additional information of the atmospheric humidity;
- ✓ The next steps for ionosphere is provide IONEX files to correct GNSS observations for PPP online service.

Thank you very much for your attention

IBGE website: **http://www.ibge.gov.br**

INCRA website: **http://ribac.incra.gov.br**

INPE/EMBRACE website: **http://www.inpe.br/climaespacial/index.php**

More information : **rbmc@ibge.gov.br**