IBGE
Instituto Brasileiro de Geografia e Estatística

Modernization and New Services of the Brazilian Active Control Network

Sonia Costa
Coordination of Geodesy

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

Medellin, 23-27 June 2008

Overview

- ✓Introduction
- ✓Adoption of SIRGAS2000 in Brazil
- ✓History
- ✓Motivation
- ✓Expansion plan
- ✓Current status of RBMC
- ✓NTRIP – real-time data via Internet
- ✓Modernization plan
- ✓Final remarks

Introduction

- ✓ Brazilian Network for Continuous Monitoring of GPS (RBMC)
  - ✓ Active geodetic control network
    - ✓ First one to be established in South America
- ✓ More than 10 years in operation
  - ✓ Main geodetic framework in Brazil
  - ✓ Main link to global reference frames
  - ✓ SIRGAS2000 is realized in Brazil mainly through its stations
- ✓ In 2005 a Geocentric Reference System – SIRGAS2000 was officially adopted in Brazil

Adoption of SIRGAS2000 in Brazil

✓ Resolution n°1/2005 officialized the adoption of SIRGAS2000 in Brazil

✓Transition period – 2005 to 2014

✓Information provided:

✓New data base available on internet

✓New geoid model + software (MAPGEO2004)

✓Transformation Parameters + software (TCGEO)

✓**PIGN** (National Geospatial Framework Project) to support activities related to the adoption: Promote, Impacts on cartography, courses…

✓PIGN is supported by CIDA (Canadian International Development Agency and ABC (Brazilian Cooperation Agency)

History

- ✓ In operation since 1997 with 9 stations
- ✓ Station Configuration:
  - ✓ Double frequency receivers /Choke ring antenna
  - ✓ Computers
  - ✓ Phone lines for communications
- ✓ Information: Daily files – RINEX format
- ✓ TEQC software is used for checking file structure and data quality
- ✓ Daily files freely available on Internet after 24h of observation date for post-mission applications

Motivation

INCRA (Instituto Nacional de Colonização e Reforma Agrária) responsibility: National Cadastre for Rural Properties

IBGE responsibility: Brazilian Geodetic System

- ✓ Law 10267/01 – Federal law requiring owners of rural property to provide a georeferenced plan for all procedures related to notariat
- ✓ Georeferencing must be connected to Brazilian Geodetic System
- ✓ Deadline:
  - ✓ Year 2008 properties between 500 and 1000 hectares
  - ✓ Year 2011 properties smaller than 500 hectares.
- ✓ Scenario:
  - ✓ Geodetic system with poor densification
  - ✓ Active GPS network maintained by INCRA was not homologated by IBGE because it was not following the standards for reference stations.

Expansion Plan

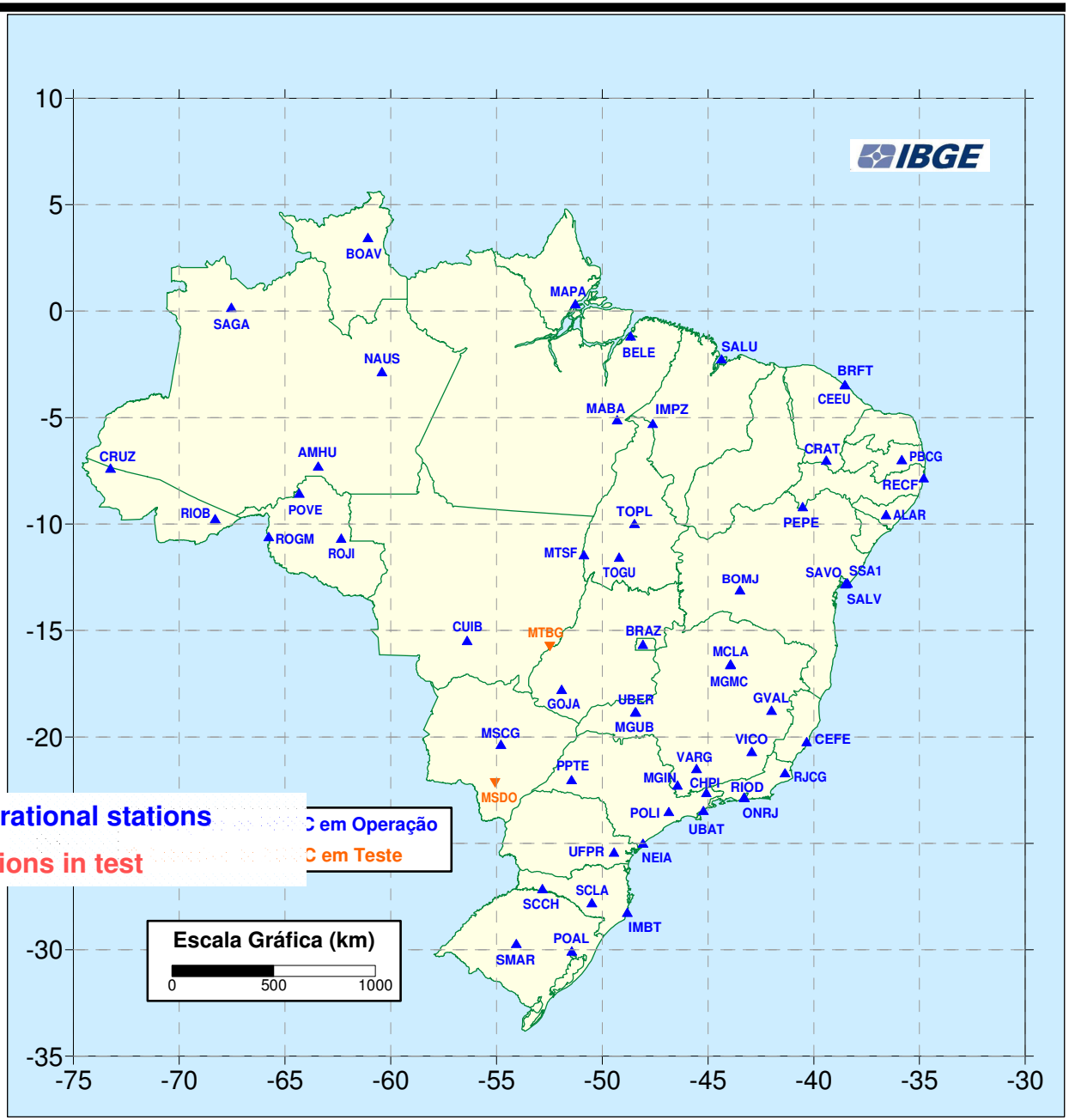
- ✓ Cooperation Agreement was signed in 2006 between IBGE and INCRA
- ✓ In 2007 INCRA acquired 83 double frequency receivers with these main features:
  - ➢ IP network port for connecting the receiver to LAN/Internet with no local computer
  - ➢ Be remotely controlled through Internet
  - ➢ Both store and transfer data through Internet to the Network Control Center
  - ➢ Be slaved to external frequency standard input
  - ➢ Possibility of L2C and L5 signals tracking or easy upgradeability
- ✓ All stations have 24 hours Internet connections (satellite link)
- ✓ Data availability: Hourly -5 sec (INCRA website) and Daily -15 sec (IBGE website)

Expansion Plan

	Nº of Receivers	
RECEIVERS	**mar/07**	**jun/08**
NetRS	2	14
NetR5	0	30
Trimble 4000SSi	17	4
Leica GRX1200	1	2
Ashtech ZFX	4	4
Ashtech UZ-12	0	1
TOTAL OF RECEIVERS	**24**	**55**

Current Status (2/4)

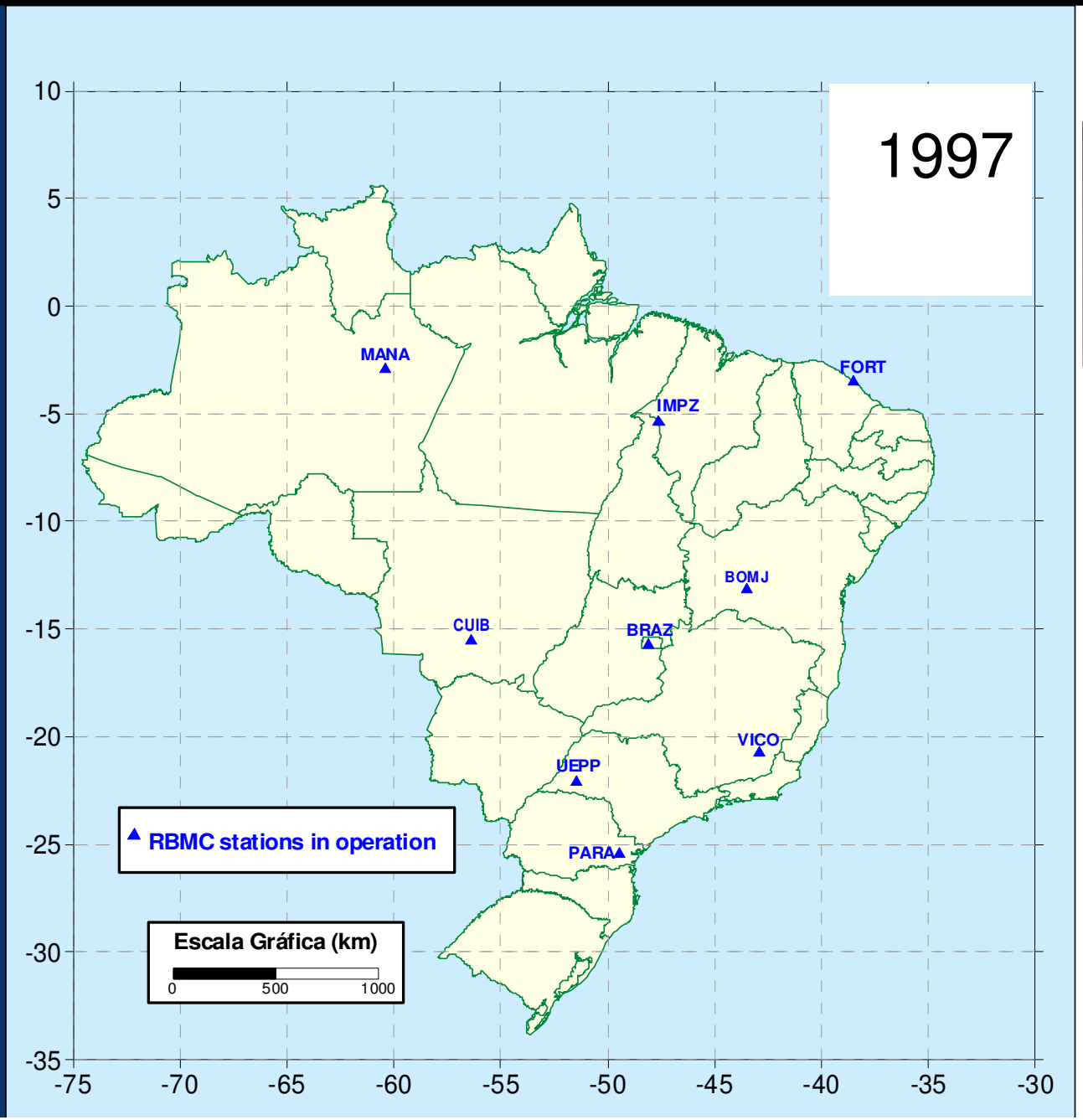
Integration of RBMC and RiBac



Current Status

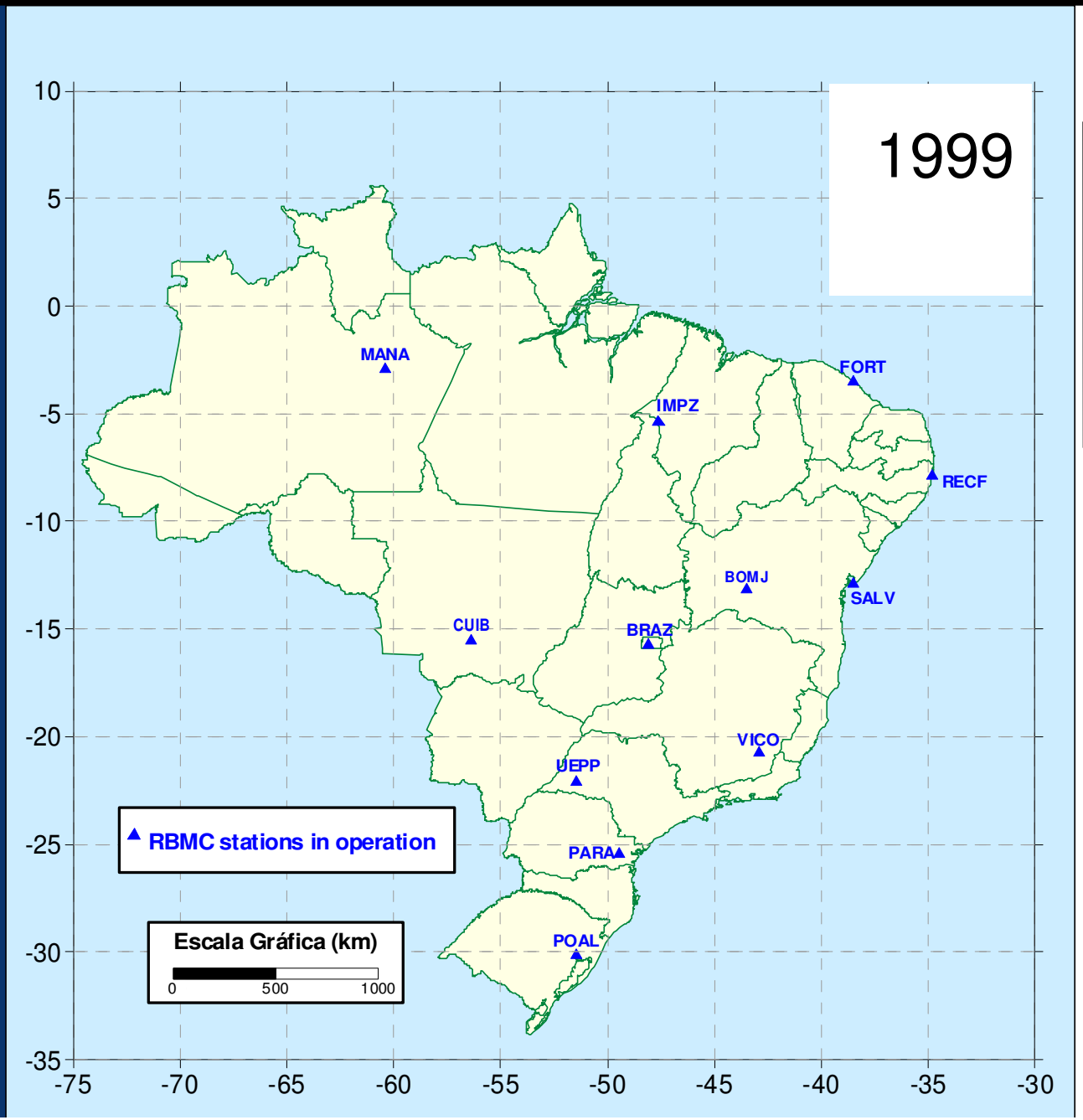
- ✓ June 2008 - 55 stations in operation
- ✓ IGS stations: BRAZ, BRFT and CHPI
- ✓ New IGS stations and RTIGS: POVE, RECF, SALU, SAVO, UFPR, CEEU, ONRJ
- ✓ More than 7000 downloads per month
- ✓ All stations belong to SIRGAS-CON densification network in Latin America and the Caribbean
  - ✓ Weekly solutions generated by IGS RNAAC SIR at DGFI
  - ✓ Additional 5 experimental processing centers in Latin America (IGAC, IBGE, IGG, INEGI, IGM) process RBMC data – along with other CORS data in Latin America - under the scope of the SIRGAS Project

Expansion Plan



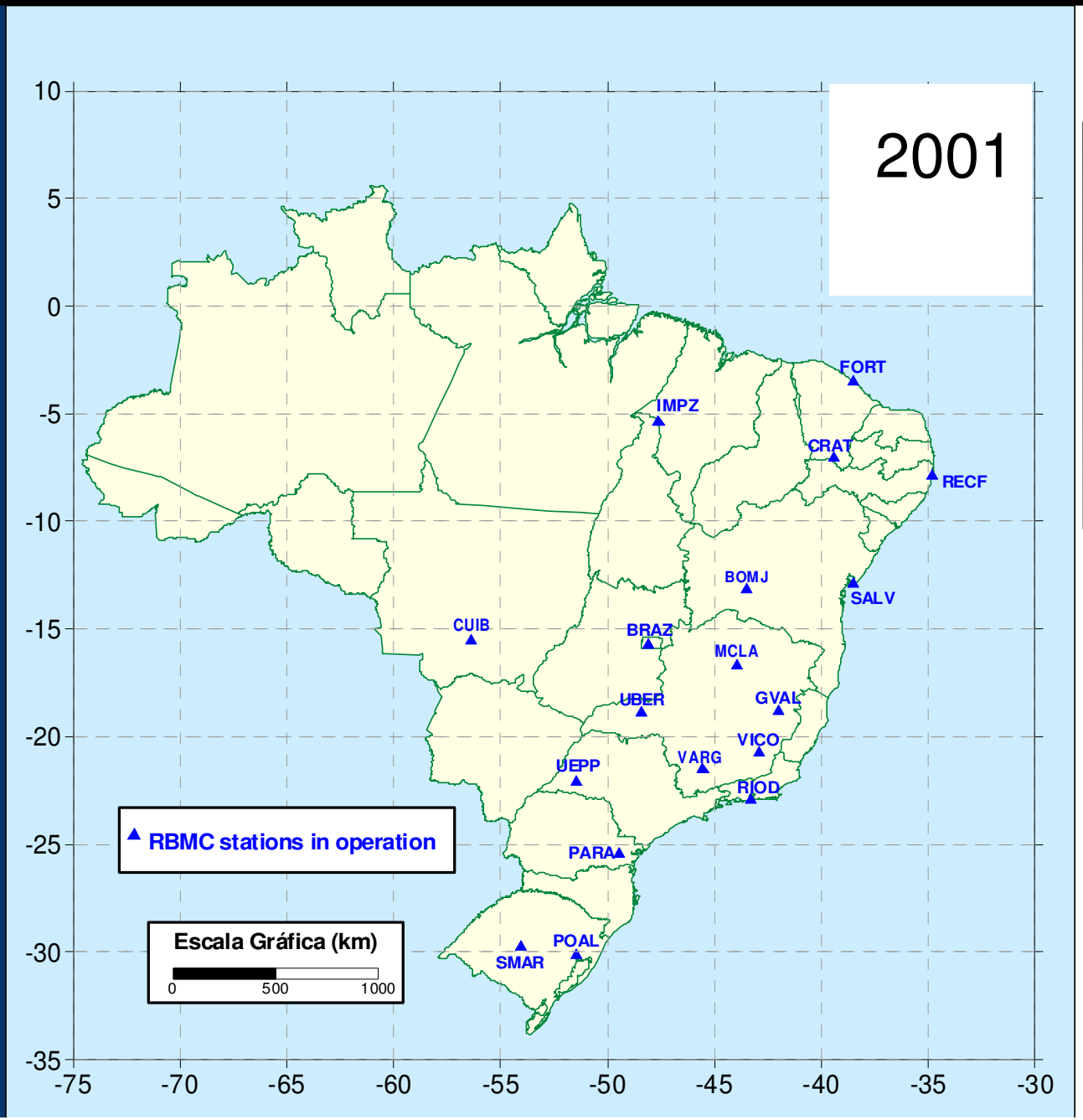
YEAR	N° OF STATIONS
1993	1
1997	9

Expansion Plan



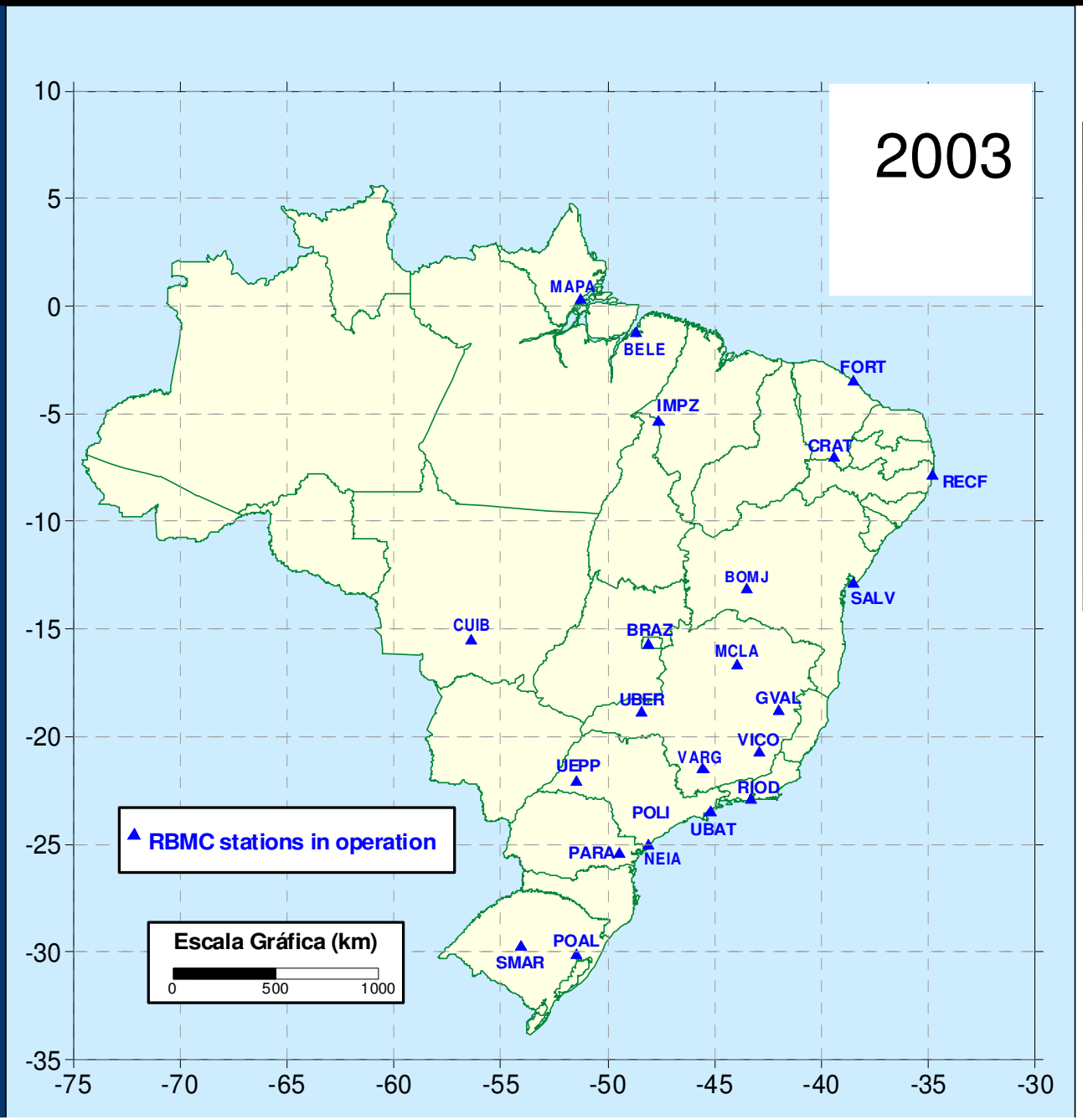
YEAR	N° OF STATIONS
1993	1
1997	9
1999	12

Expansion Plan



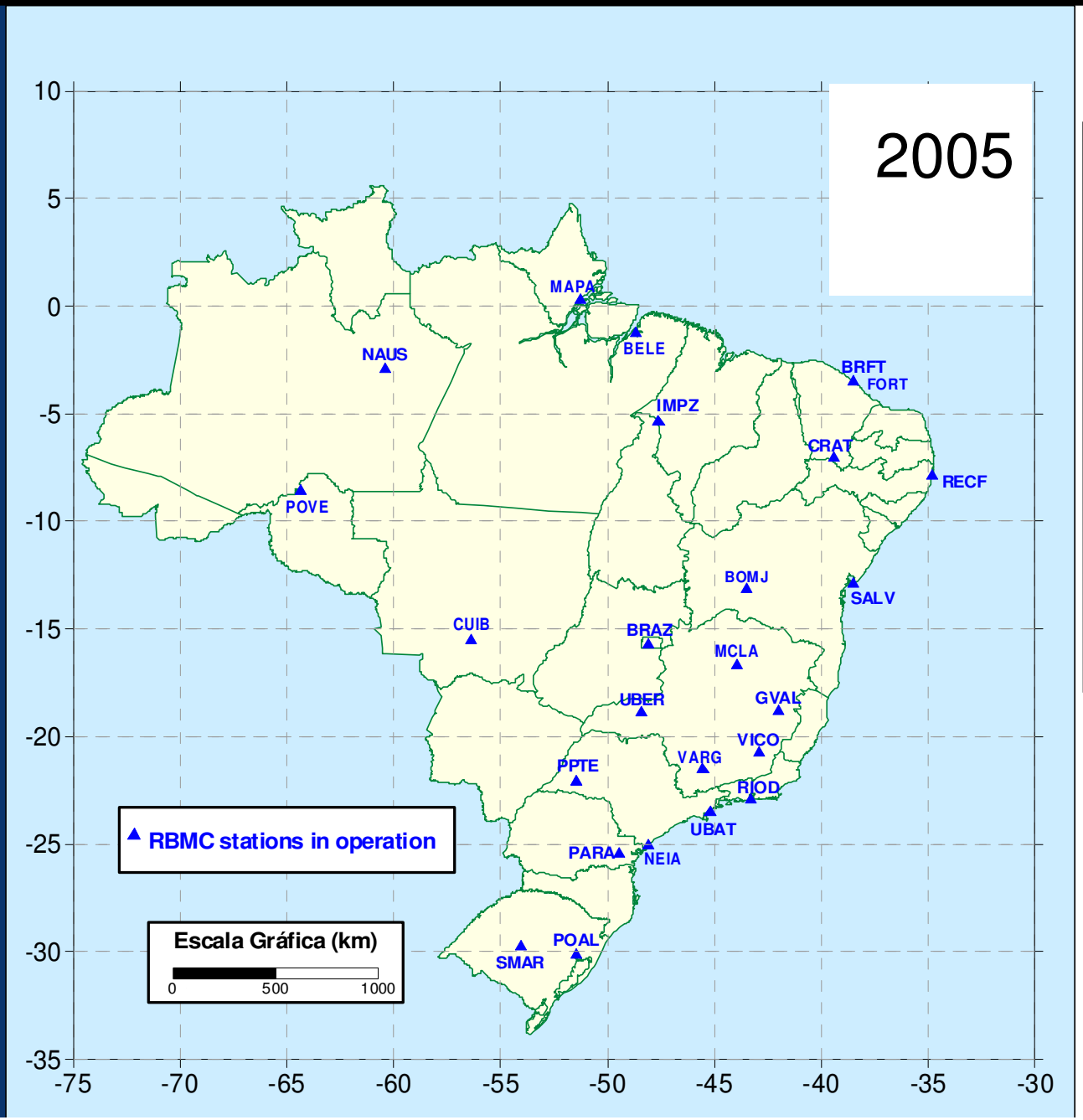
YEAR	N° OF STATIONS
1993	1
1997	9
1999	12
2001	18

Expansion Plan



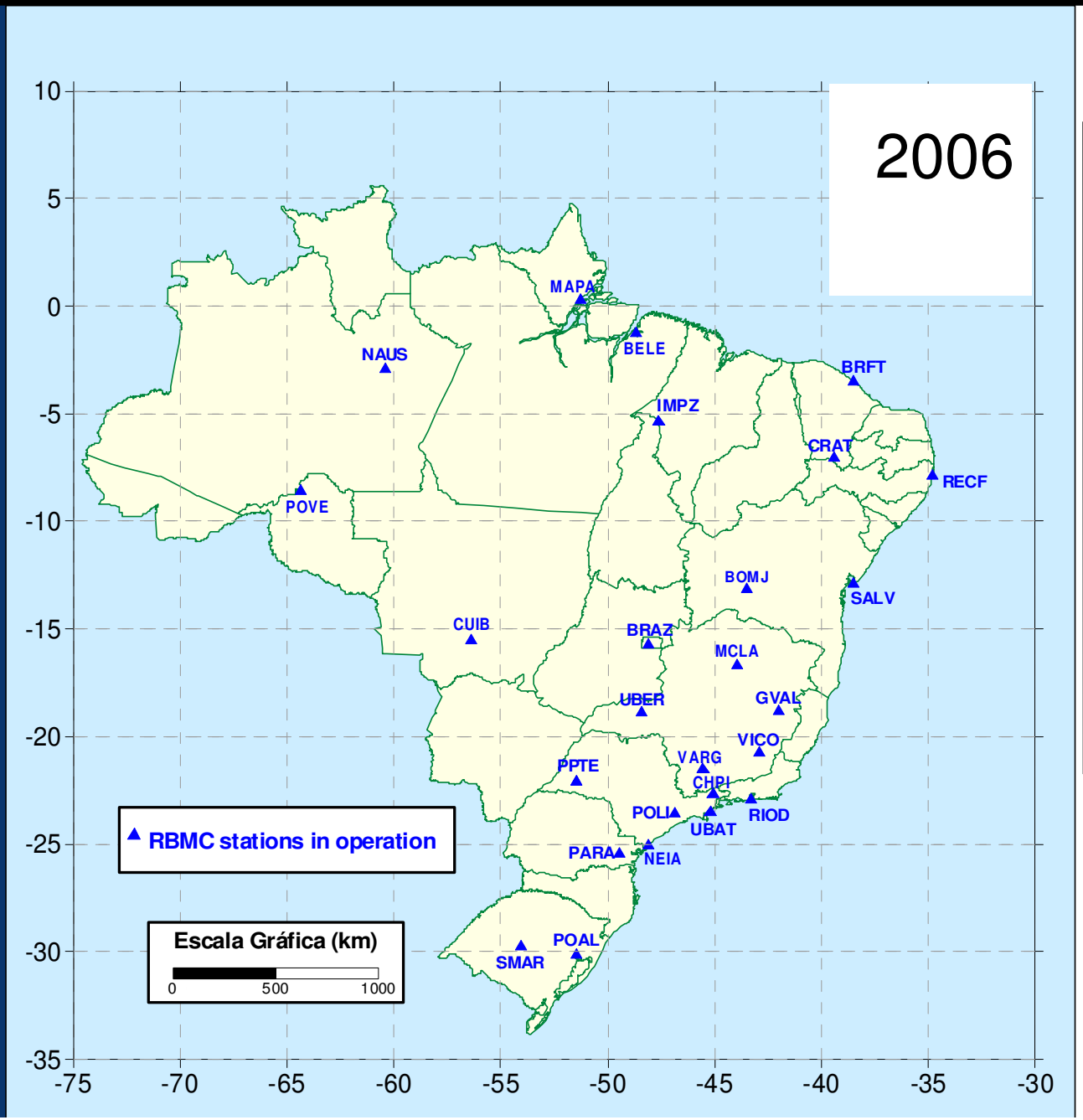
YEAR	N° OF STATIONS
1993	1
1997	9
1999	12
2001	18
2003	22

Expansion Plan



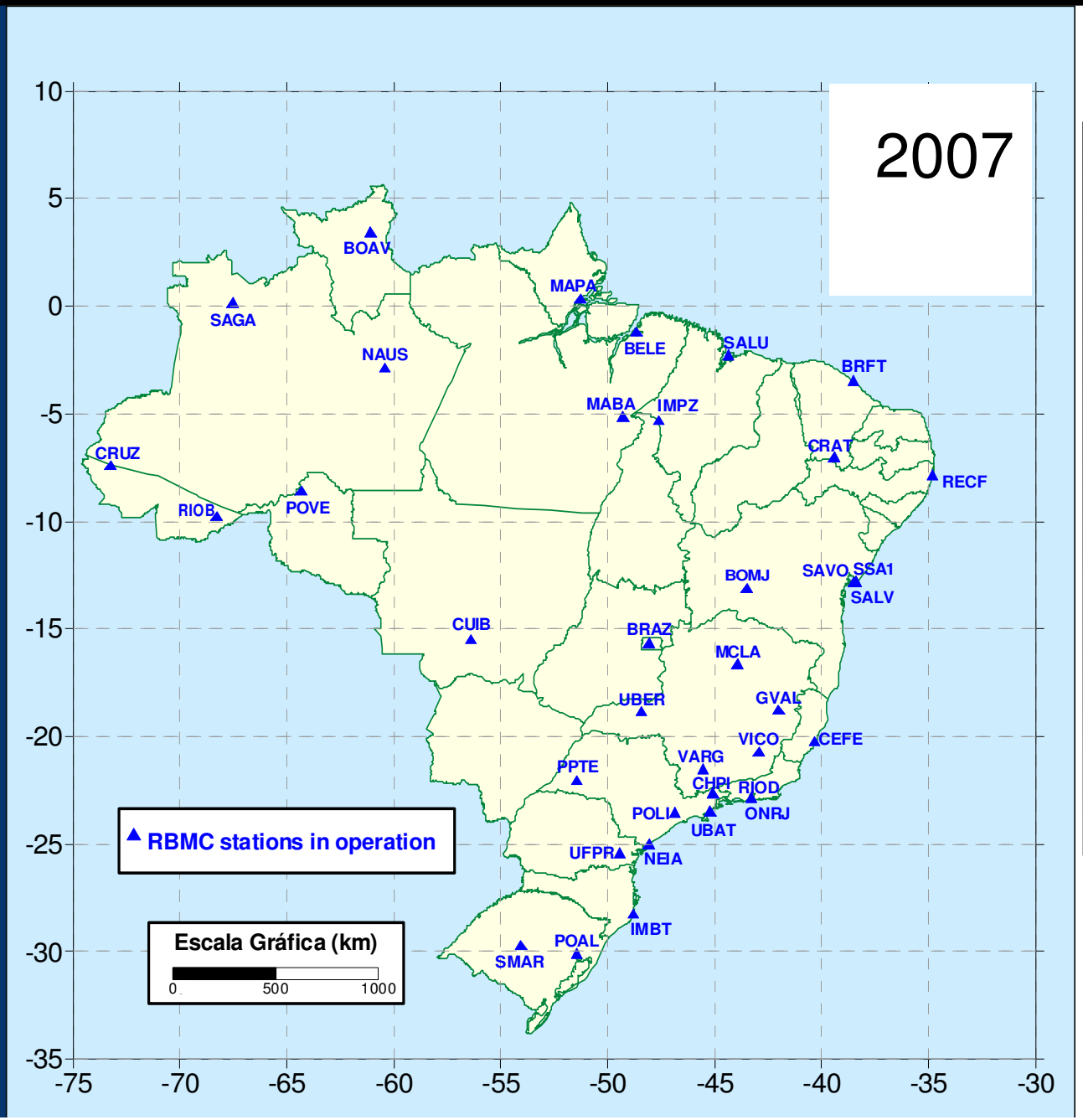
YEAR	N° OF STATIONS
1993	1
1997	9
1999	12
2001	18
2003	22
2005	25

Expansion Plan



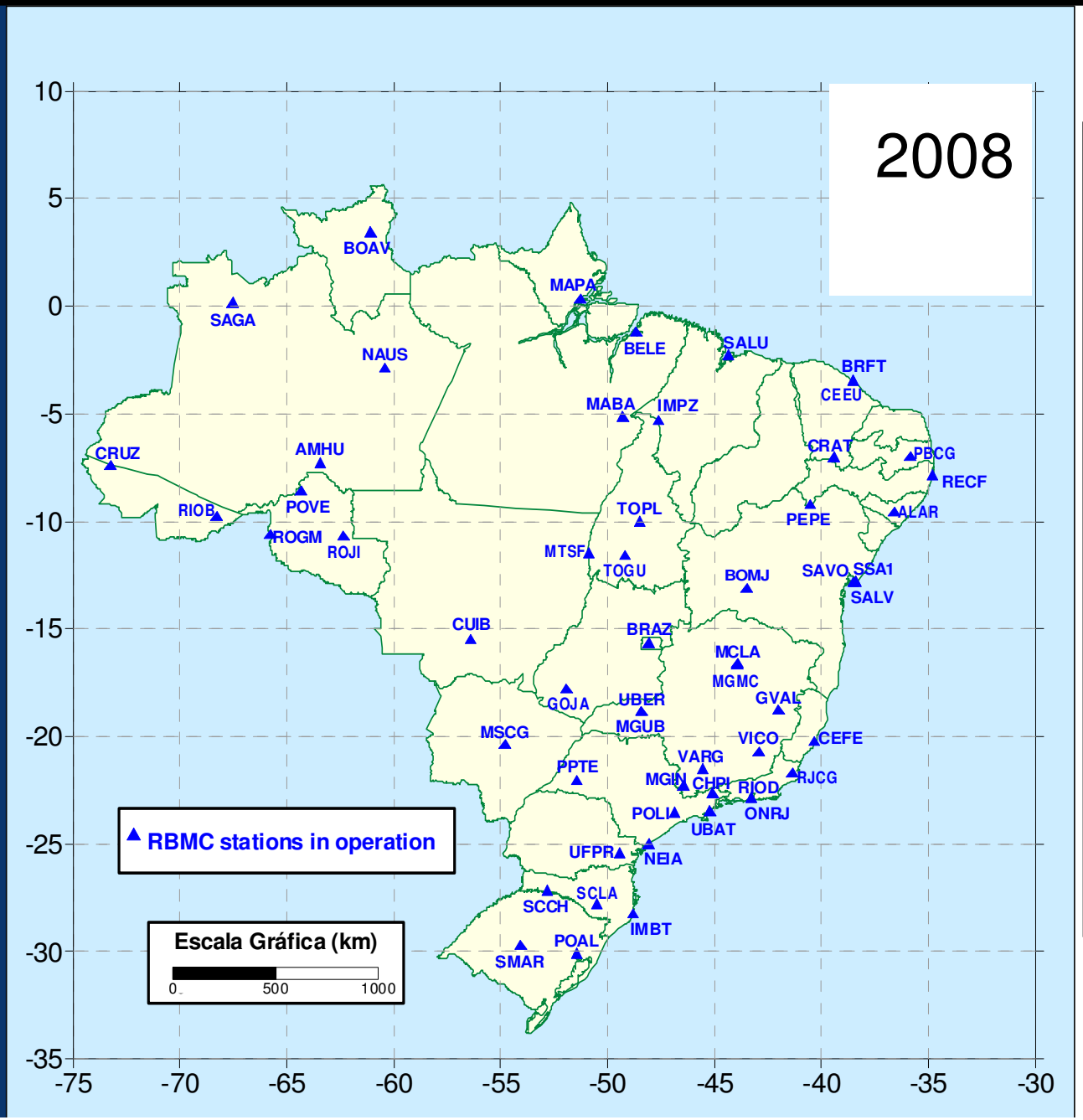
YEAR	N° OF STATIONS
1993	1
1997	9
1999	12
2001	18
2003	22
2005	25
2006	27

Expansion Plan



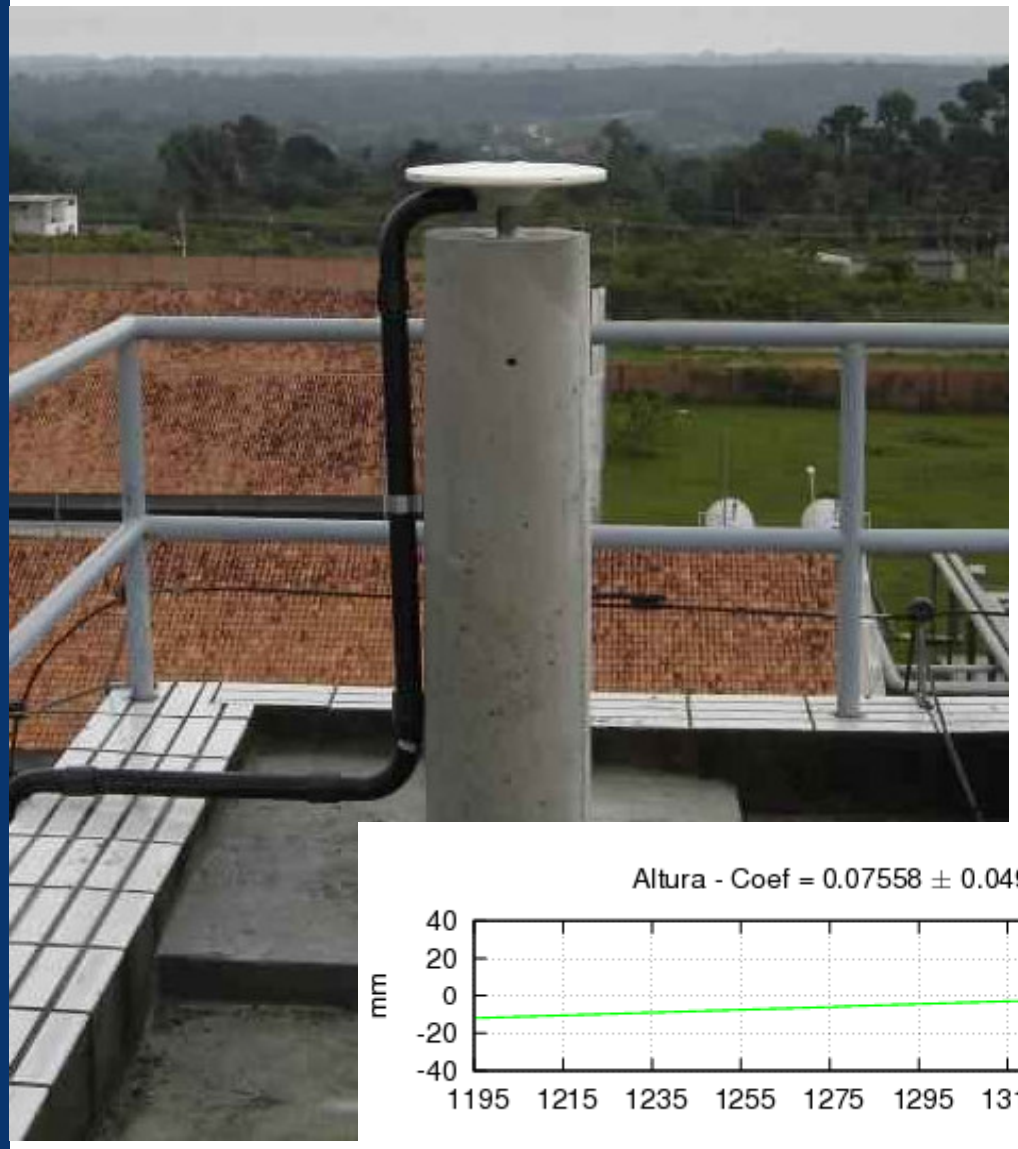
YEAR	N° OF STATIONS
1993	1
1997	9
1999	12
2001	18
2003	22
2005	25
2006	27
2007	37

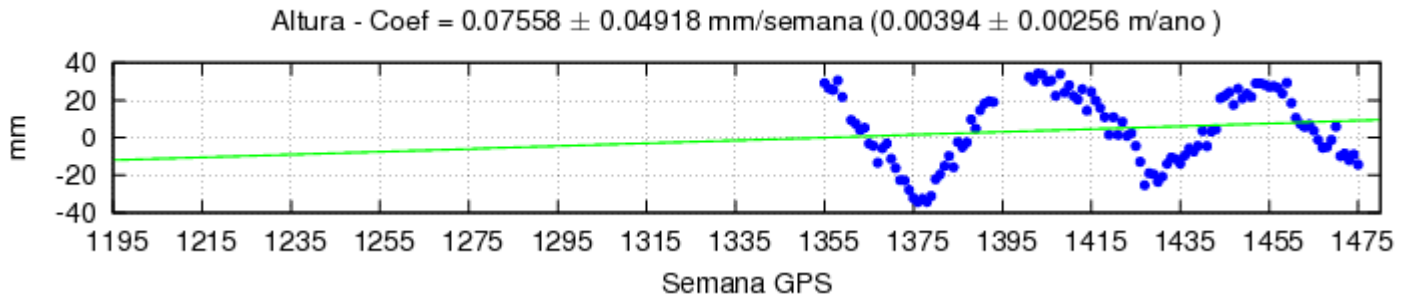
Expansion Plan



YEAR	N° OF STATIONS
1993	1
1997	9
1999	12
2001	18
2003	22
2005	25
2006	27
2007	37
2008	55

Station NAUS – Amazon Region





New Stations

Data Quality Control

- ✓ Data Archival:
  - ✓ RINEX format
  - ✓ IGS Broadcast orbits (brdcDDD0.YYn)
  - ✓ 24 hour sessions
  - ✓ 15 sec observation rate
  - ✓ Observation and broadcast orbits compacted in ZIP format
- ✓ RINEX files header fixed with program RBMCheck
- ✓ TEQC software used for checking file structure and quality

Website


Ministério do Planejamento, Orçamento e Gestão
Destaques do governo
Instituto Brasileiro de Geografia e Estatística
ENGLISH ✦ ESPAÑOL
LINKS ✦ FALE CONOSCO ✦ MAPA DO SITE
BUSCA
OK
BUSCA AVANÇADA
ORDEM E PROGRESSO
Indicadores
População
Economia
Geociências
Canais
Download
Pesquisas
Geodésia
Introdução
SGB
Introdução
Rede Planimétrica
Rede Altimétrica
Rede Gravimétrica
Redes Estaduais GPS
Banco de Dados
Modelo Geoidal
RBMC
Introdução
Estações
Informações
Download
RMPG
Introdução
Estações
Download
SIRGAS
Mudança do Referencial
Introdução
Parâmetros de Transformação
FAQ
Documentação
Artigos Técnicos
Especificações e Normas
Homologação de Marcos
Clique aqui para fazer download do Acrobat Reader
Rede Brasileira de Monitoramento Contínuo - RBMC
Pesquisa combinada para download
Atenção:
- Caso haja algum problema na execução da consulta, tente buscar os dados diretamente na área de Download, clicando aqui .
- Para mais informações (estações em manutenção, novas estações, etc.) veja o item Informações.
São disponibilizados dois tipos de arquivos, sendo eles:
Relatório da estação
Fornece detalhes sobre a estação da RBMC, incluindo a altura da antena e coordenadas precisas da estação(xxxx.PDF, sendo xxxx o código da estação). Este arquivo tem um tamanho aproximado de 6 kb.
Arquivos de dados
São arquivos compactados com os dados de observação (exemplo: BOMJ0331.O04) e navegação (exemplo: BOMJ0331.N04) da estação. Este arquivos são identificados como xxxxddd1.ZIP, sendo ddd o dia do ano e xxxx o identificador da estação. Este arquivo tem aproximadamente 1,6 Mb.
Por exemplo, um pedido de dados das estações Viçosa e Bom Jesus da Lapa, para os dias 2 e 3 de fevereiro, resultaria no fornecimento dos arquivos BOMJ0331.ZIP VICO0331.ZIP e BOMJ0341.ZIP VICO0341.ZIP.
Selecione as Estações:
Belém
Boa Vista
Bom Jesus da Lapa
Brasília
Cachoeira Paulista
Campo Grande
Cananéia
Crato
Cruzeiro do Sul
Cuiabá
Curitiba UFPR
Fortaleza *
Fortaleza 2005
Guajará-Mirim
Governador Valadares
Selecione as datas:
(à partir de 01 / 01 / 2006 os dados ficarão disponíveis pelo período de 1 ano)
Jun
2008
Seg Ter Qua Qui Sex Sab Dom
Hoje : 3 Jun 2008
Consultar
Limpar
Nota: A exibição dos
PMRG
CLIQUE AQUI E DEIXE A SUA OPINIÃO SOBRE OS IMPACTOS DESTA MUDANÇA!
servidor de mapas
agora é
Mapas Interativos
Banco de Dados Geodésicos
ATLAS
geográfico escolar
Saiba mais
NOVO
DOWNLOAD
GEOCIÊNCIAS
agora com + informações

NTRIP – real-time data via internet

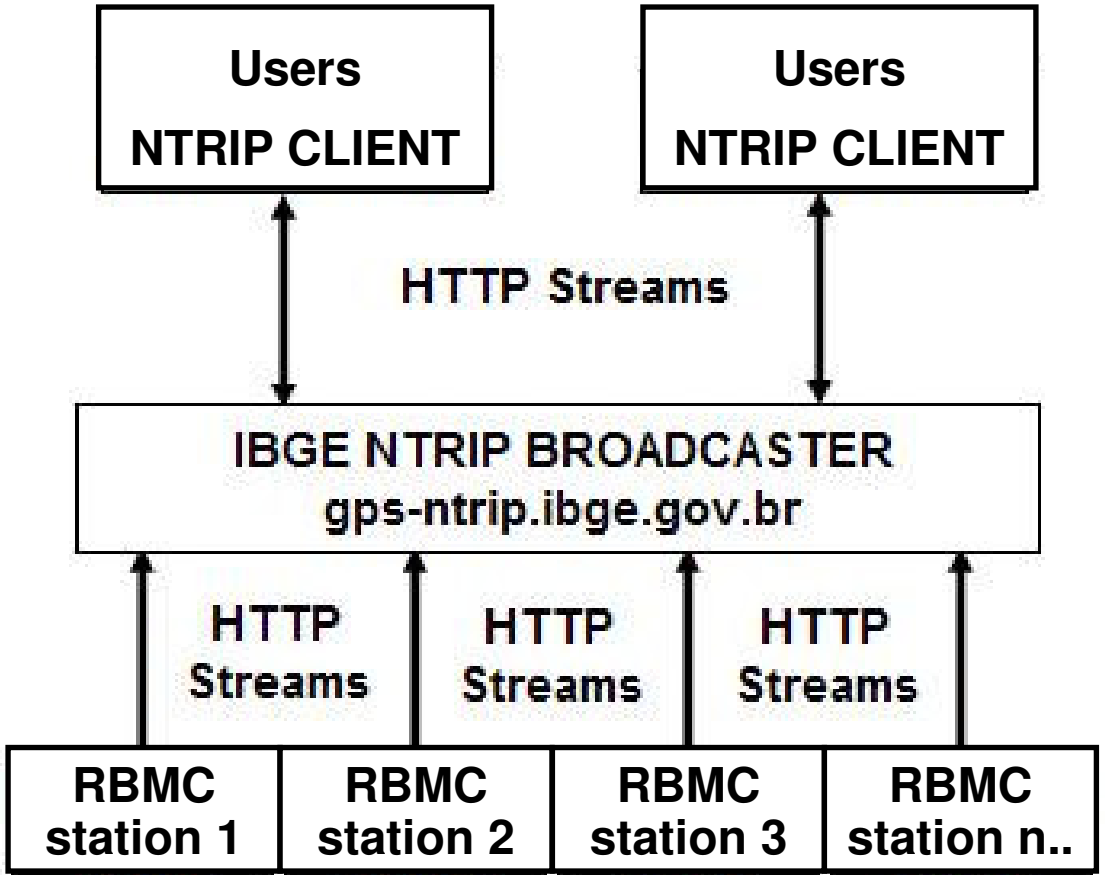
NTRIP – Networked Transport of RTCM via Internet Protocol

- ✓ Protocol developed by Federal Agency for Cartography and Geodesy (BKG), Germany.
- ✓ Composed of a subset of HTTP protocol and thus based on TCP. All data streaming is carried out using one single IP port, in most cases port 80 or 2101.
- ✓ Streaming GNSS real-time data in RTCM (version 3) format or any GNSS format (RAW, RINEX).
- ✓ Open source software, available for LINUX and Windows platforms.
- ✓ NTRIP usage: real-time applications - DGPS/RTK
- ✓ RBMC real-time data availability:

  22 stations in **gps-ntrip.ibge.gov.br:2101** broadcaster

  9 stations in **www.igs-ip.net:2101** broadcaster

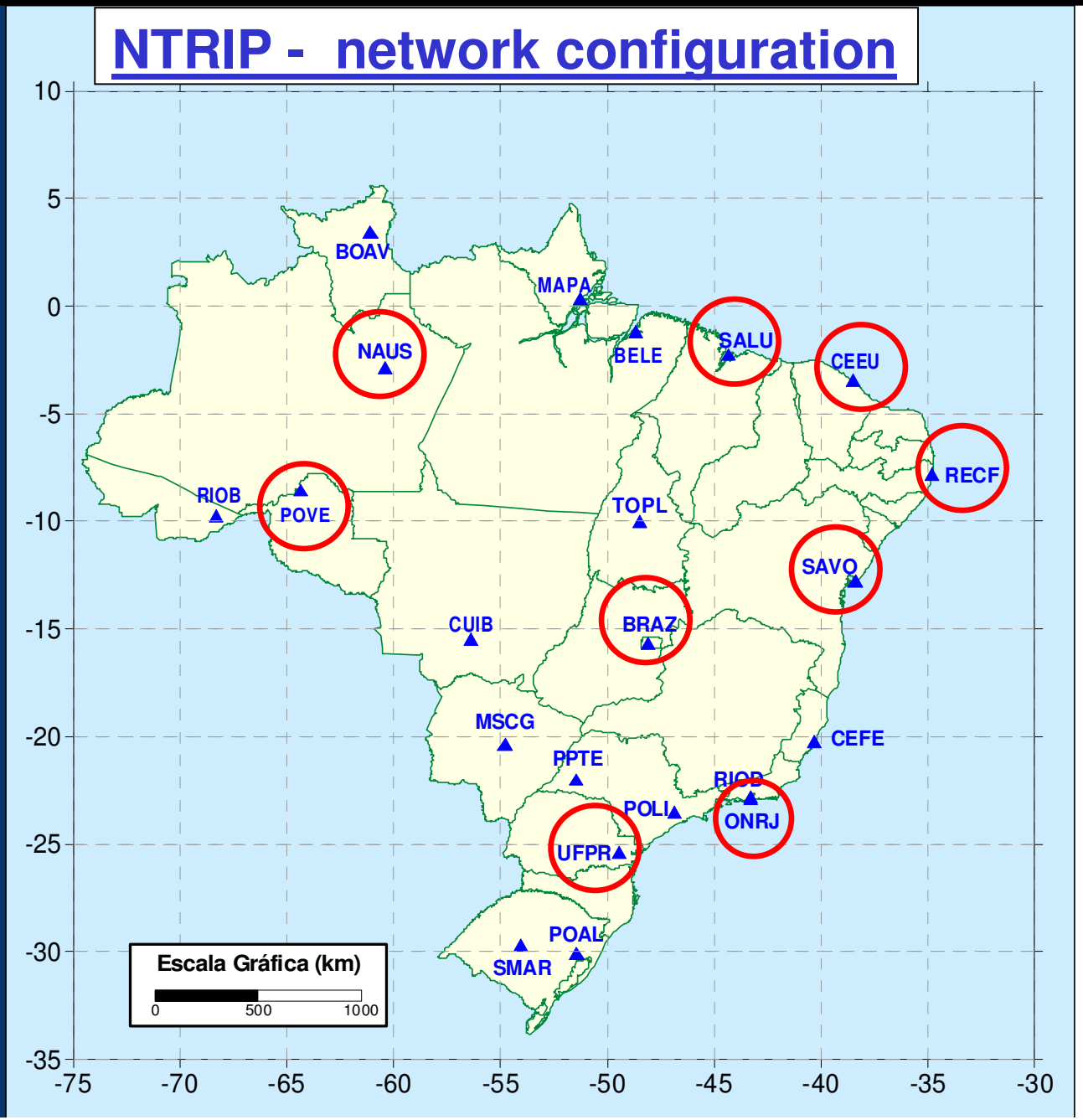
NTRIP Scheme



NTRIP - Clients

- Receiving GNSS data streams via:
  - **GNSS Internet Radio** (PC/Laptop, PDA, or cell phone). Transfers received GNSS data to a serial or IP port to RTK or DGPS application.
  - **BKG NTRIP Client (BNC):** Transfers RINEX observation and navigation files to support near real-time GNSS post-processing applications or monitoring data streams

NTRIP - network configuration



- ✓ 20 stations in state capitals
- ✓ 2 stations in Universities

Proposal : SIRGAS–IP Pilot Project

- ✓IGS is incentivating institutions (data centers or data operators) to provide real time or near real time data –RTIGS
- ✓This will also mark an important step towards global and unrestricted stream exchange.
- ✓As a consequence this will open a way to generate and disseminate real-time products like satellite orbits, clocks, atmosphere maps.

Modernization Plan

- ✓ Cooperation Project between IBGE / University of New Brunswick (UNB) / Canadian International Development Agency (CIDA) / Agência Brasileira de Cooperação (ABC);
- ✓ Generate and provide real-time WADGPS corrections;
- ✓ Technology transfer from NRCan – **CDGPS** (The Real-Time Canada Wide DGPS Service);
- ✓ **Pilot Project:** 6 stations (Santa Maria, Rio de Janeiro, Cuiabá, Fortaleza, Rio Branco, Belém) – transmitting data for computation of WADGPS corrections and send through Internet;
- ✓ **Expected precision in horizontal component:**
  - ✓ about 1 meter (95%) for single frequency users,
  - ✓ about 0,5 meter (95%) for double frequency users.
- ✓ **Schedule:** Installation of systems (RTAP and GPSC), evaluation and tests (2008) and operationalization (2009).

Modernization Plan - Equipment

- ✓ **2 servers HP - Itanium2 (Processing)**

  Configuration: Proc. 1.6 Ghz / 6 Mb-cache / 2 HD SCSI 73Gb 2Gb RAM

- ✓ **5 servers Opteron Dual Core (Data Base)**

  Configuration: Proc. 1.8 Ghz / 2 Mb-cache / 4 HD SATA 400Gb / 2Gb RAM

- ✓ **Time server** (in acquisition)

- ✓ No break system for the Control Center

MACS Configuration for RBMC Real-Time Correction Service

Stations ONRJ and CEEU

Atomic clock

GPS receiver

Console of Control Center

Data translator
Data archiver
(Linux dual-core)

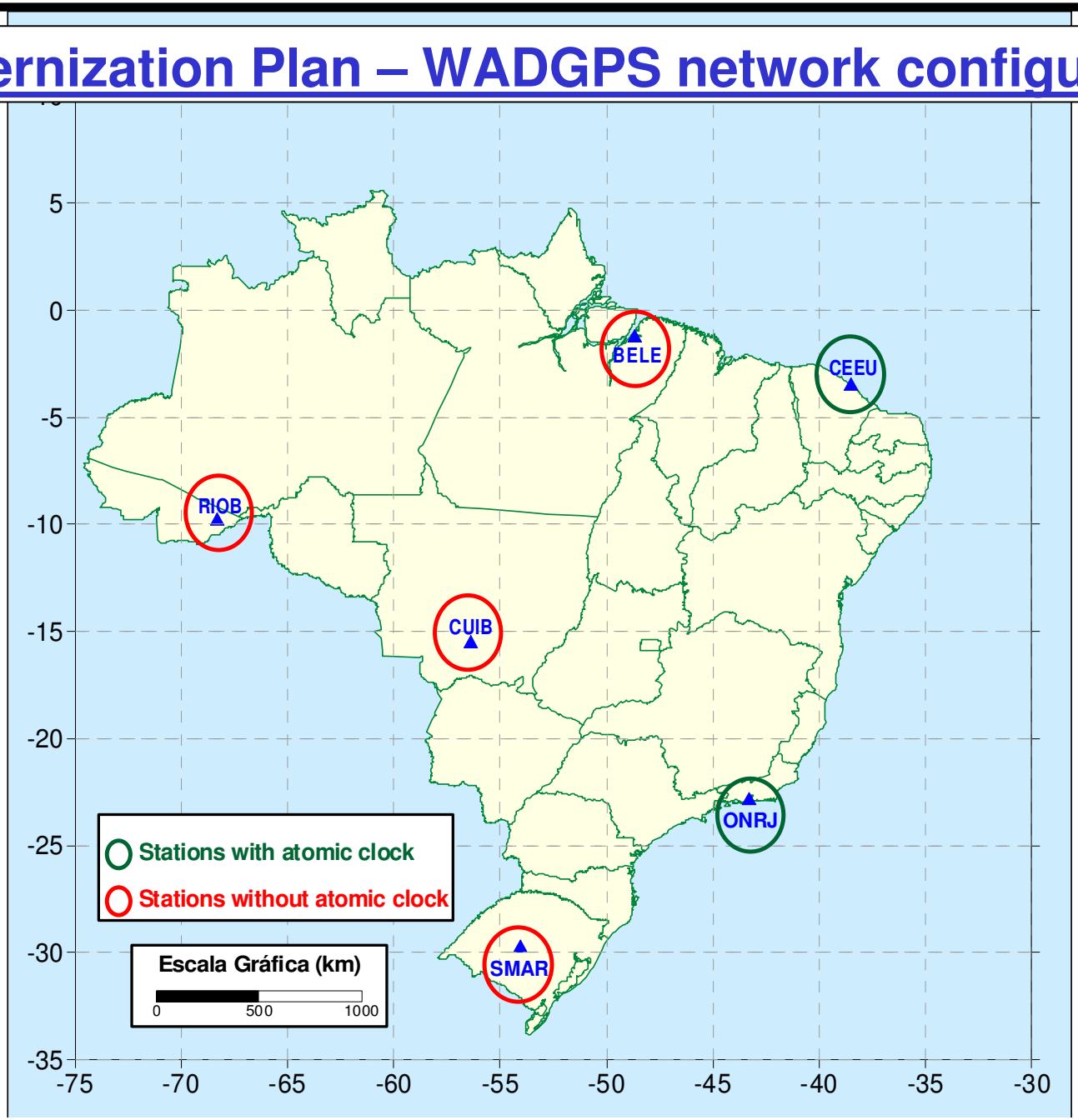
Time Server
(receiving 1PPS of one receiver of 1PPS
or
1PPS from a rubidium synchronized to GPS)

Master Active Control System

HP Itanium

IBGE real-time GPS correction LAN

Modernization Plan – WADGPS network configuration



Plans for modernizing RBMC functionality and new service to users

- ✓ Transfer 1-Hz real time data from stations to the Network Control Center, located in Rio de Janeiro
- ✓ Generate real-time WADGPS corrections (orbit, clocks and ionosphere)
- ✓ Make corrections available to users in Brazil (and surrounding areas) through Internet and/or communication satellite
- ✓ Offer accuracies of **1 meter** (95%) horizontal to **single-frequency users** and **0.3 meter** (95%) to dual-frequency users in real time and **cm level** for dual frequency post processing
- ✓ Collaborate with international organizations such as the IGS Real Time Working Group and IGS CB.

Partners

- ✓ **INCRA** – acquisition of new receivers
- ✓ **Observatório Nacional (ON)** – atomic clock at station ONRJ
- ✓ **Instituto Nacional de Pesquisas Espaciais (INPE)** – atomic clock at station CEEU
- ✓ **The Canadian International Development Agency (CIDA)** for funding towards the modernization of the RBMC
- ✓ NRCan/GSD for technology transfer
- ✓ Several Brazilian agencies supporting the operation of the RBMC network

Final Remarks

- ✓ RBMC will continue working in post-mission mode since its establishment in 1997,
- ✓ Main geodetic framework in Brazil allowing users to precisely link surveys to SIRGAS2000,
- ✓ Provide real-time data to Brazilian users via internet – NTRIP,
- ✓ Resulting structure will support real-time services, including WADGPS,
- ✓ Will provide a rapid and transparent connection of SIRGAS2000 to Brazilian users,
- ✓ Collaborate with international organizations such as the IGS Real Time Working Group and IGS CB.

Thank you very much for your attention.

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

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