

Brazilian infra-structure for Seismological and GNSS monitoring networks

Marcelo Bianchi
(w/ contributions from different people)

Seismological Center / USP

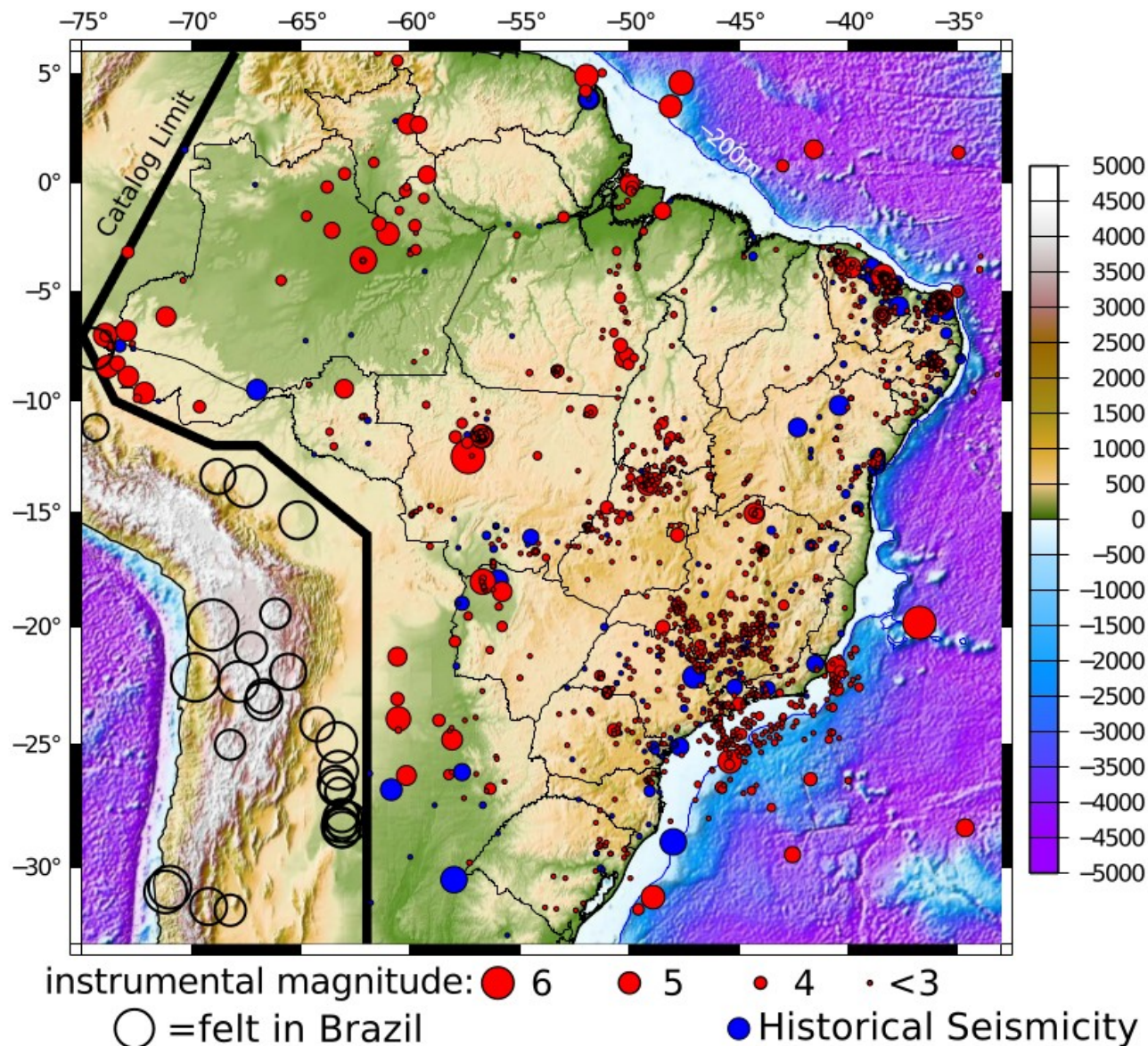
Updated on
May 25, 2015

Overview

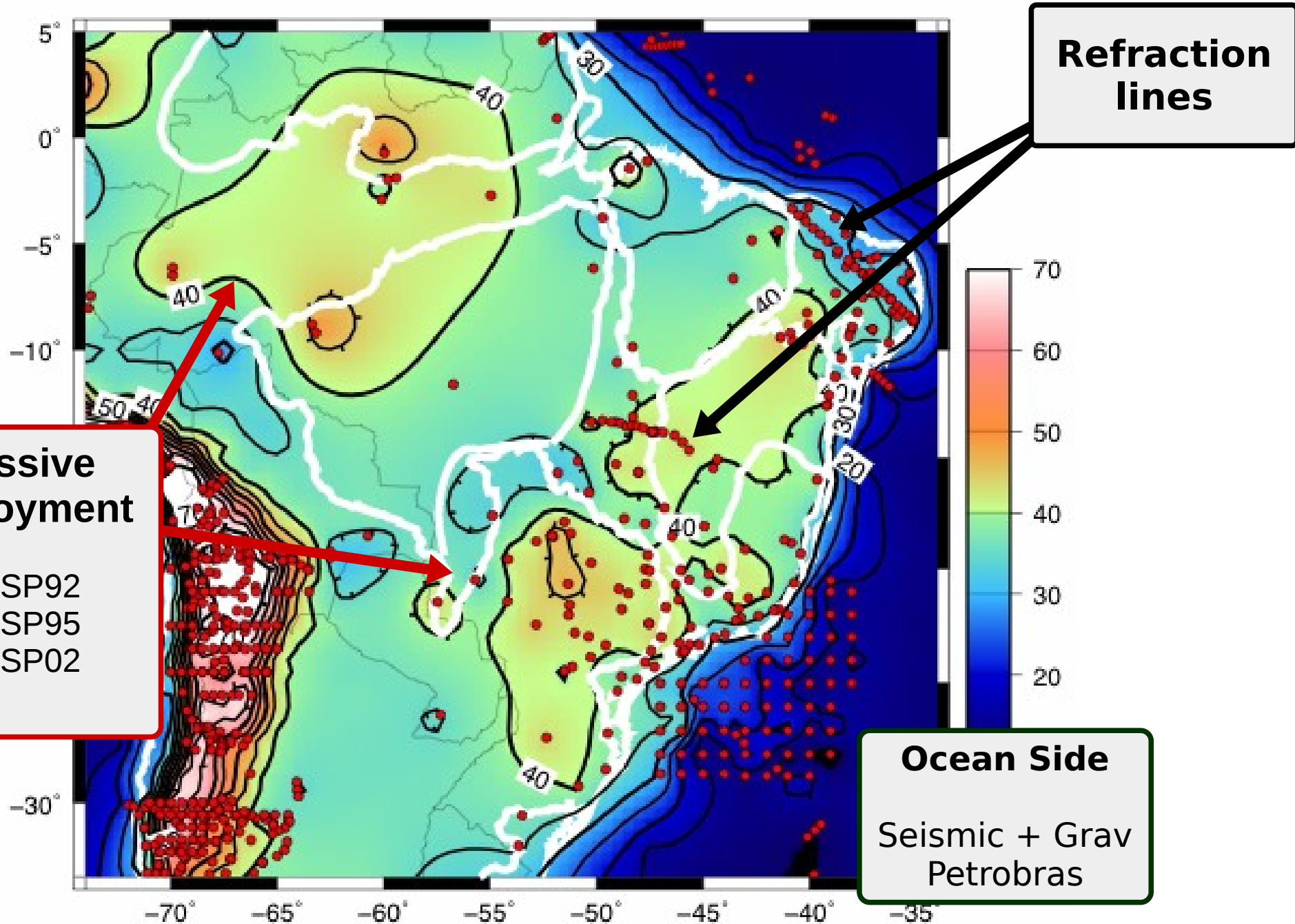
- Brazilian Seismic Bulletin – BSB
- Past temporary experiments / stations
- RSBR – Real-time network
- Near-future deployments
- Instrument Pool
- RBMC – A GNSS network

Brazilian Seismic Bulletin

Brazilian Earthquakes, 1720-2015/02

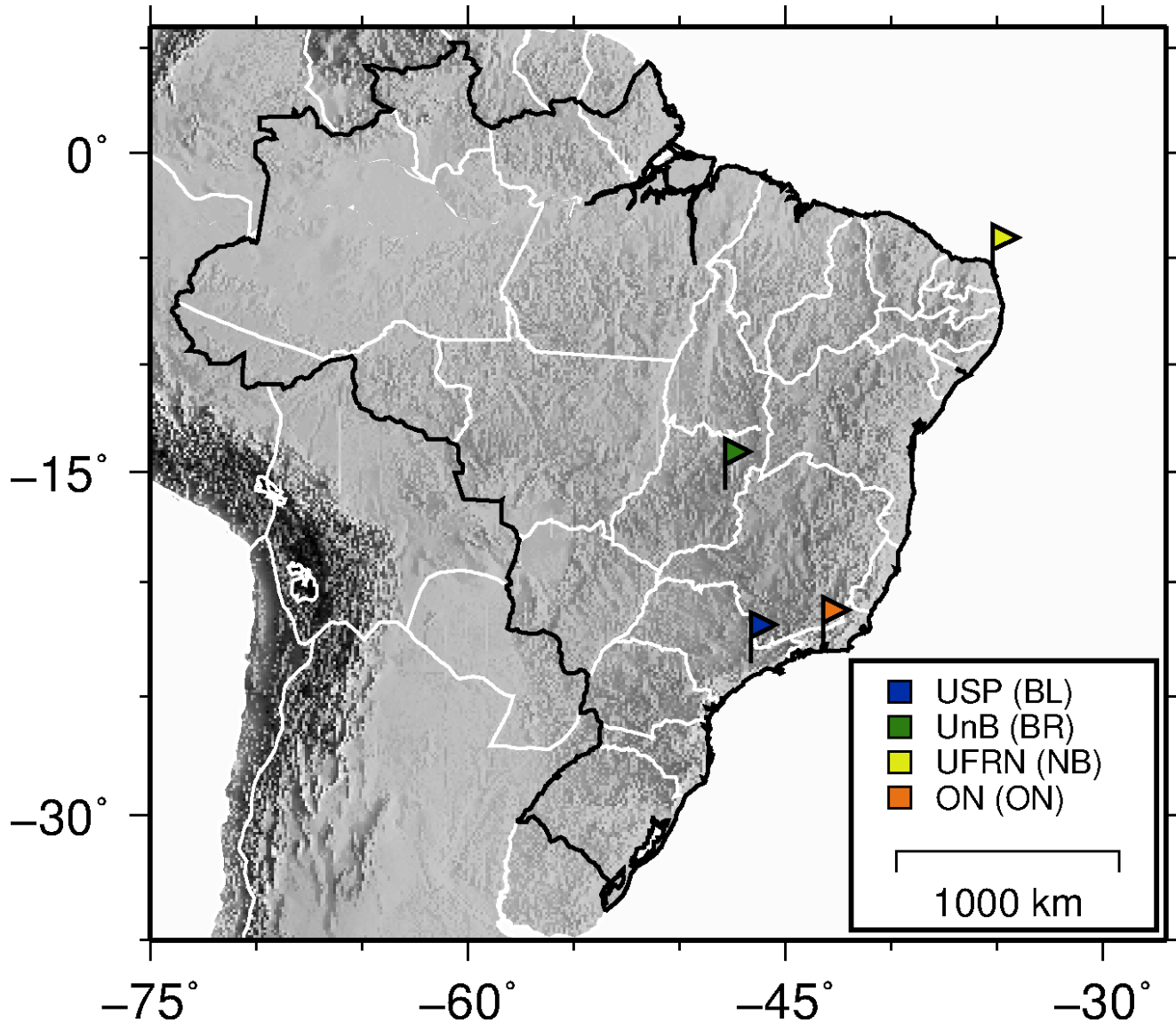


Crustal Thickness Map & Past Temp. Deployments



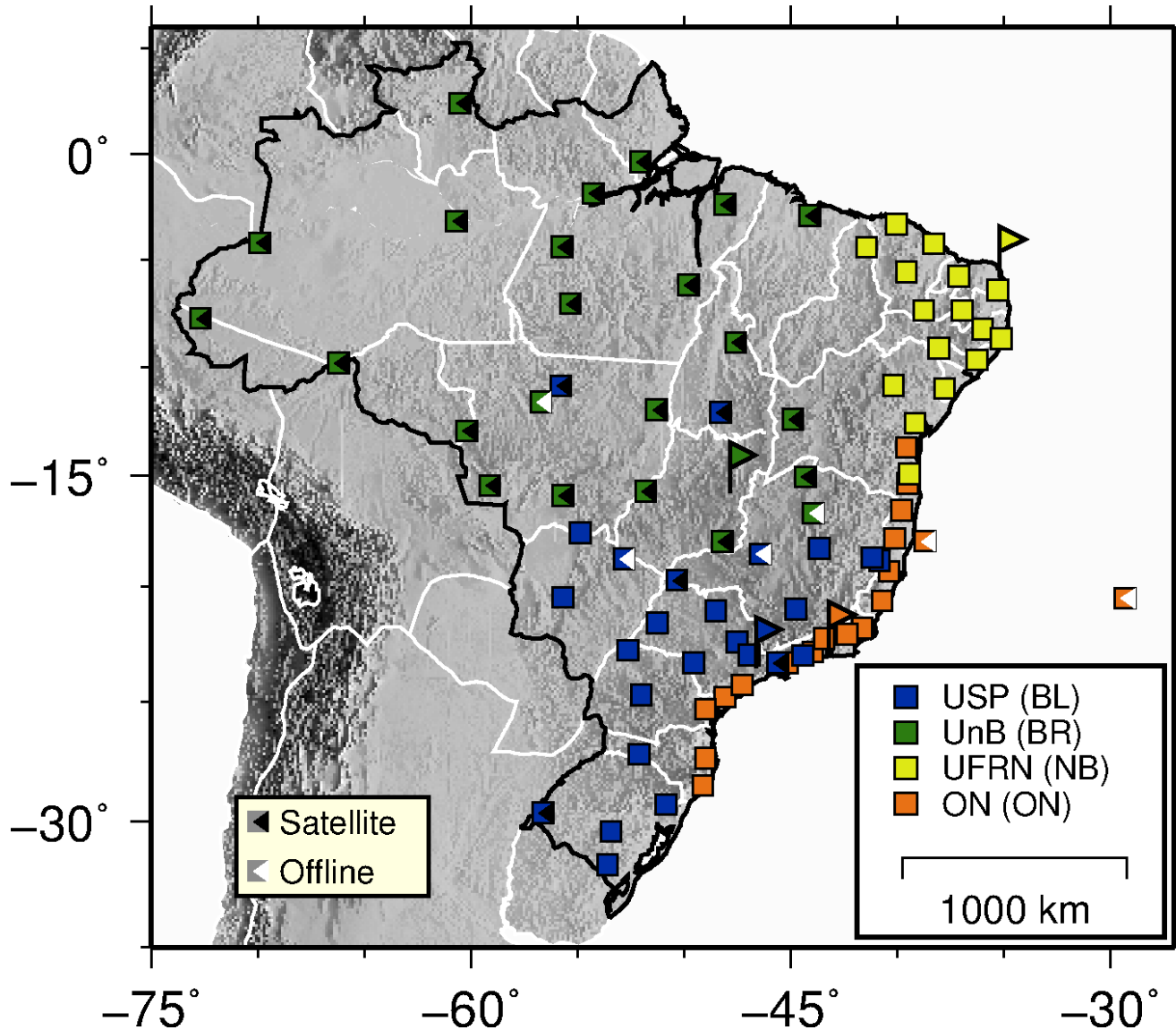
Seismology

real-time



- 4 Main Institutions
 - ON (Rio de Janeiro/RJ)
 - USP (São Paulo/SP)
 - UnB (Brasília/DF)
 - UFRN (Natal/RN)

Seismology real-time



- 4 Networks

- ON (18) → ON
- USP (25) → BL
- UnB (23) → BR
- UFRN (16) → NB

- RSBR

- Total of 81 BB stations + 16 Accelerometers (*not shared*)

Typical station sites

- Stations are deployed over large rock sites, inside masonry constructions filled with soil and fenced inside a private property;



- BL/PTLB



- ON/CAM01

Instrumentation

USP (BL)

Nanometrics Trillium
120PA + Taurus /
Signus

ON (ON)

Streckeisen STS-2 +
Quanterra Q330

UFRN (NB)

Reftek RT151 (120s) +
RT131A-02 (Acc) +
RT130G

UnB (BR)

Nanometrics Trilium
120PA (or CMG-40T) +
Taurus/Signus

Transmission

USP (BL)
V-Sat / 2G / Radio

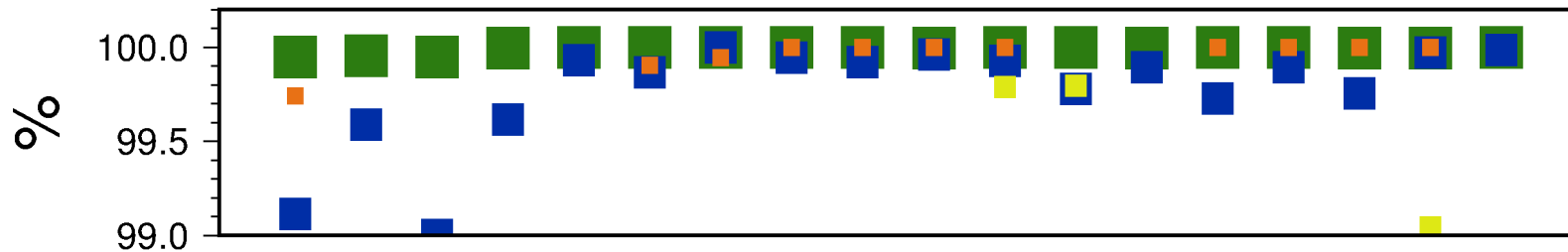
ON (ON)
2G

UFRN (NB)
Radio

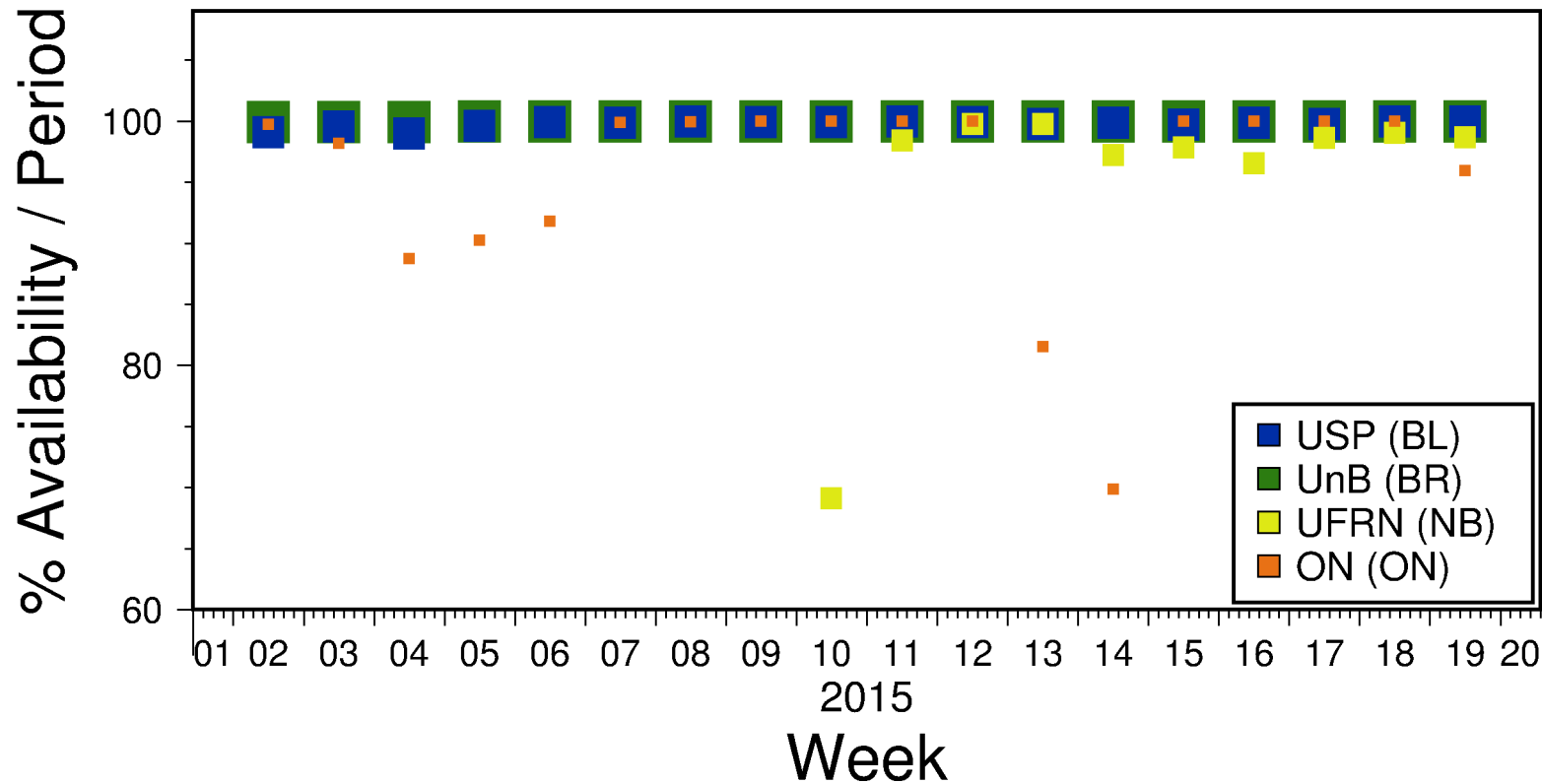
UnB (BR)
V-Sat

Near Real-time Availability

weekly



- % Availability per Network (median station channels) in a 7 days week as NRT archived by USP data center;

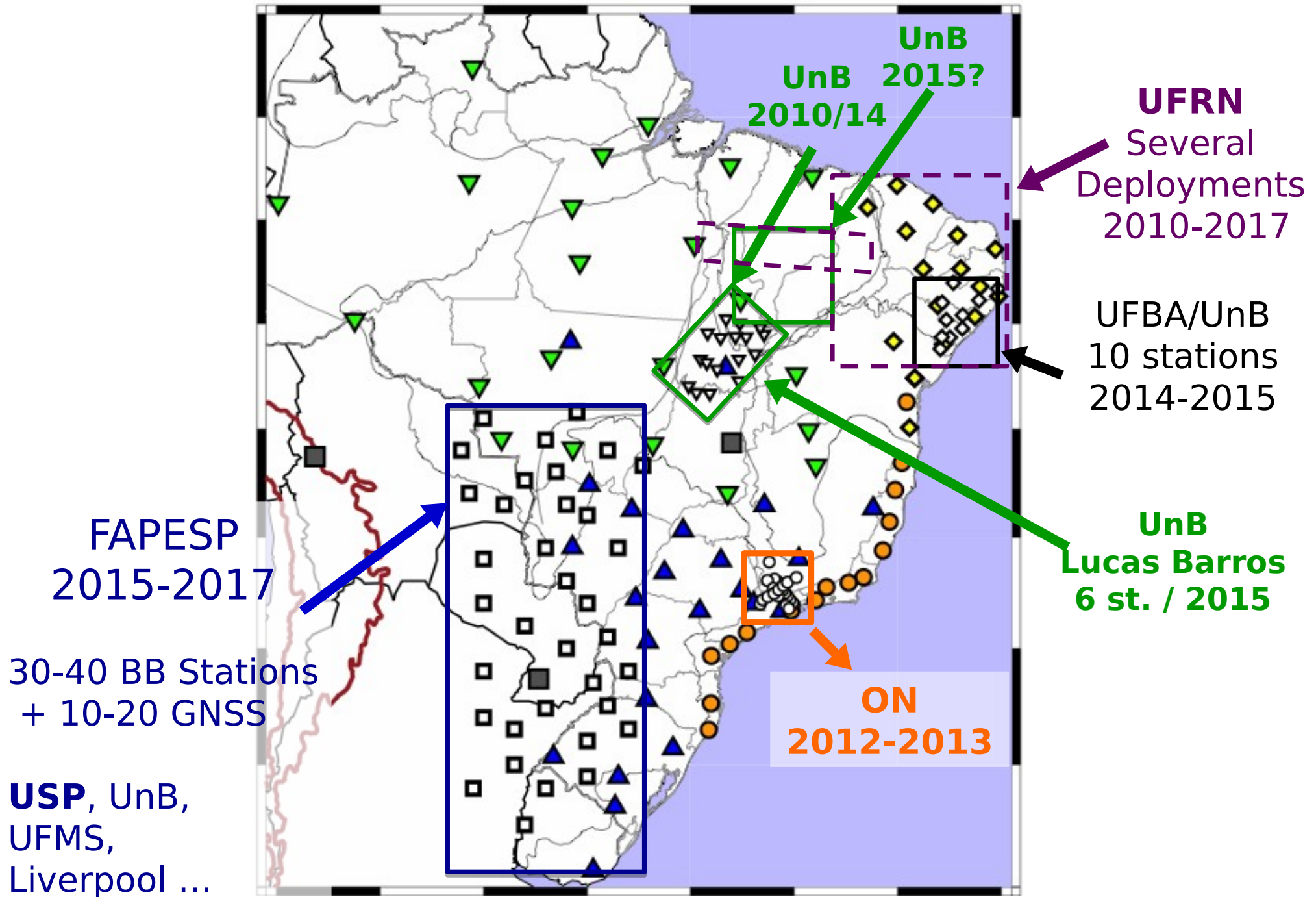


Data Sharing

- Data is Open
 - ON is the synchronization HUB / Master Archive Node
- Sharing is done using SeedLink, ArcLink + FDSNws¹

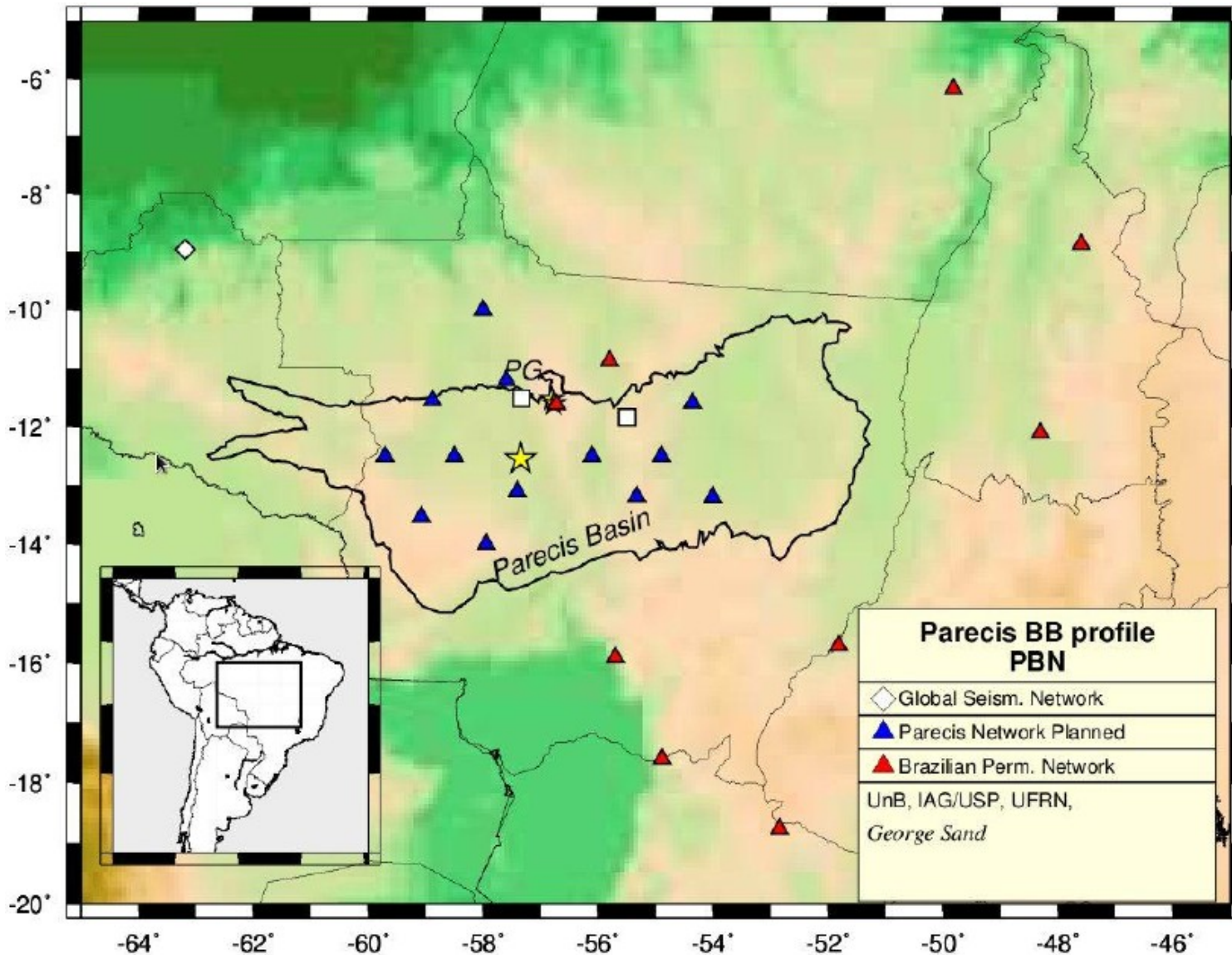
Node	Net-works	SeedLink Server (port is 18000)	ArcLink Server (port is 18001)
ON <i>http://www.rsbr.gov.br/</i>	ALL	rsis1.on.br	rsis1.on.br
UFRN	NB	sislink.geofisica.ufrn.br	-
USP ¹ <i>http://www.moho.iag.usp.br/</i>	BL+BR	seisrequest.iag.usp.br	seisrequest.iag.usp.br
UnB <i>http://www.obsis.unb.br/</i>	BR	datasis.unb.br	datasis.unb.br

Current and Future Deployments



Parecis project

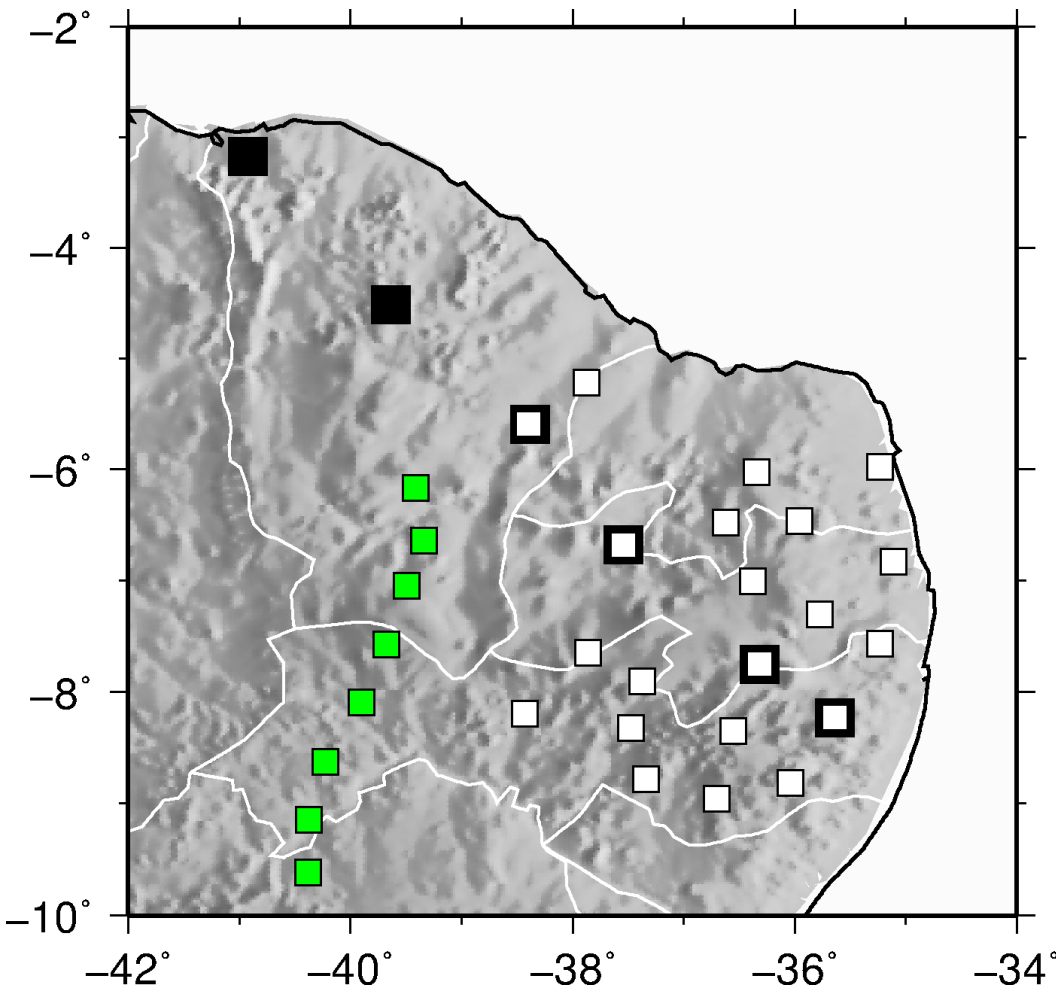
contributed by França / UnB



- Crust and lithospheric structure in the area;
- 13 BB stations + 2 RSBR;
- 2 years operation;
- improve local seismicity evaluation;

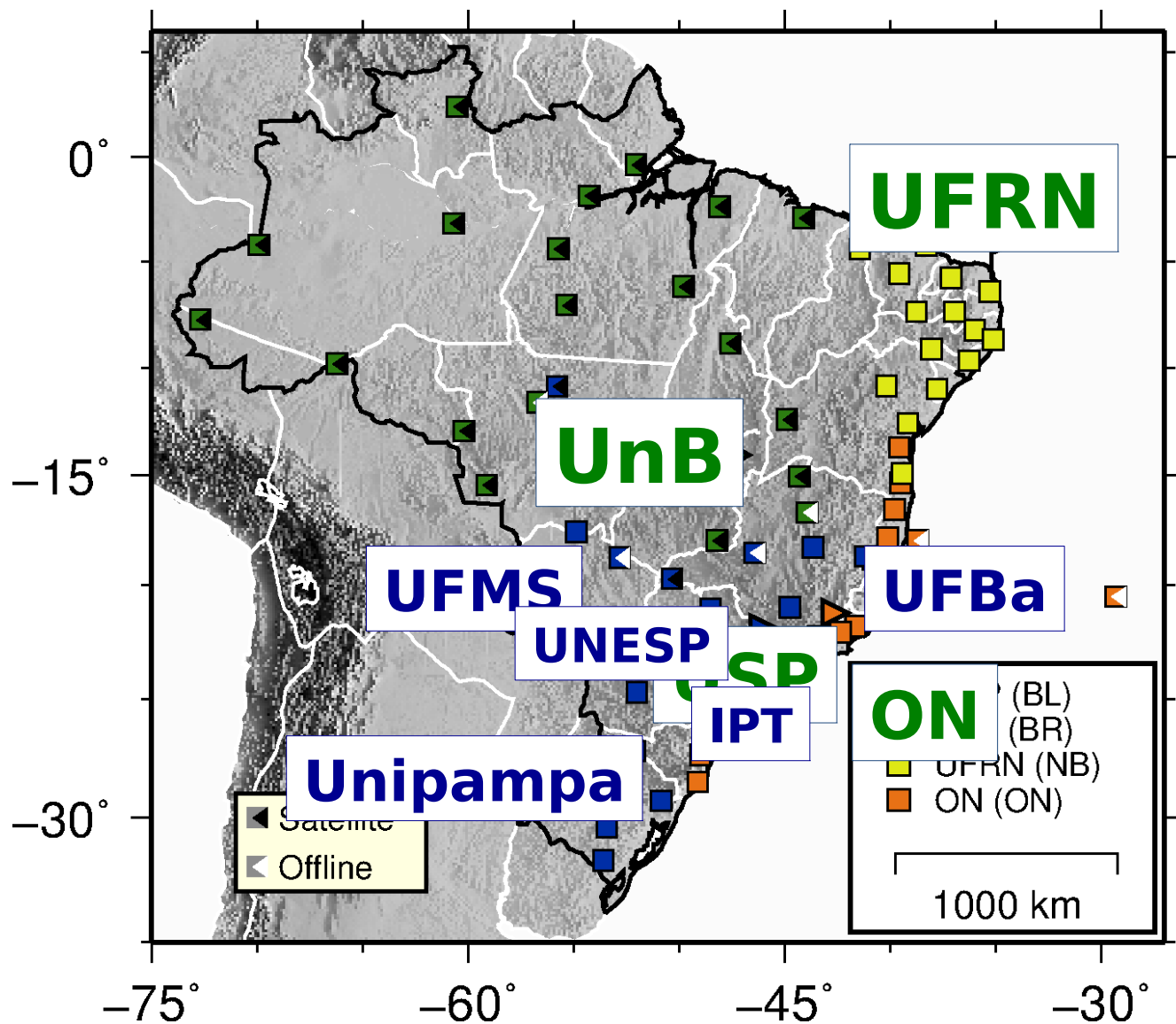
UFRN Temporary Projects

contributed by Jordi / UFRN



- Stations from UFRN/INCT-ET project operated from 2011 – 2013
 - 6 Broad Band (■)
 - 21 Short Period (□)
- Stations from Jan/2015 to Jan/2017 (BODES project)
 - 8 Broad Band (■)
- Still to be installed this year 2015.02 a project in the Parnaíba Basin (east of Borborema province)

Other Institutions doing Seismology



- IPT
- UNESP
- UFMS
- Unipampa
- UFBA

Instrument Pool



pegBR
Pool de Equipamentos Geofísicos do Brasil

Observatório Nacional

SISTEMAS DE AQUISIÇÃO DE DADOS
SÍSMICA - Banda Larga

- :: INÍCIO
- :: NORMAS DO POOL
- :: EQUIPAMENTOS
- :: SOLICITAÇÃO DE EQUIPAMENTOS
- :: SOLICITAÇÃO DE DADOS
- :: NOTÍCIAS DO POOL
- :: INTRANET
- :: CONTATO

"Nossa missão é oferecer suporte instrumental à comunidade geocientífica brasileira, com o objetivo de contribuir para o conhecimento geológico do território nacional".

O Brasil implantou um Pool de equipamentos de geofísica para dar suporte a projetos de pesquisa. A idéia foi proposta por cientistas dos diversos institutos de pesquisa e universidades que constituem a Rede Temática de Estudos Geotectônicos coordenada pela Petrobras, a saber: ON, USP, UnB, UFRN, UNESP, UFOP, UERJ, UFF, UFPR, UFRGS, UFRJ, INPE, UFMG e UNICAMP.

O Pool está equipado e conta com instrumental para sismologia, gravimetria, magnetometria e geoeletricidade (Método Magnetotelúrico e eletromagnético transiente). A utilização destes equipamentos permite estudos de temas relevantes, tais como da estrutura crustal e litosférica da placa Sul-Americana, da interação crosta continental e oceânica e da relação da estruturação do embasamento na evolução de bacias sedimentares. O pool está instalado nas dependências do Observatório Nacional, no Rio de Janeiro.

  Ministério de Minas e Energia  

<http://www.pegbr.on.br/>

Instrument Pool

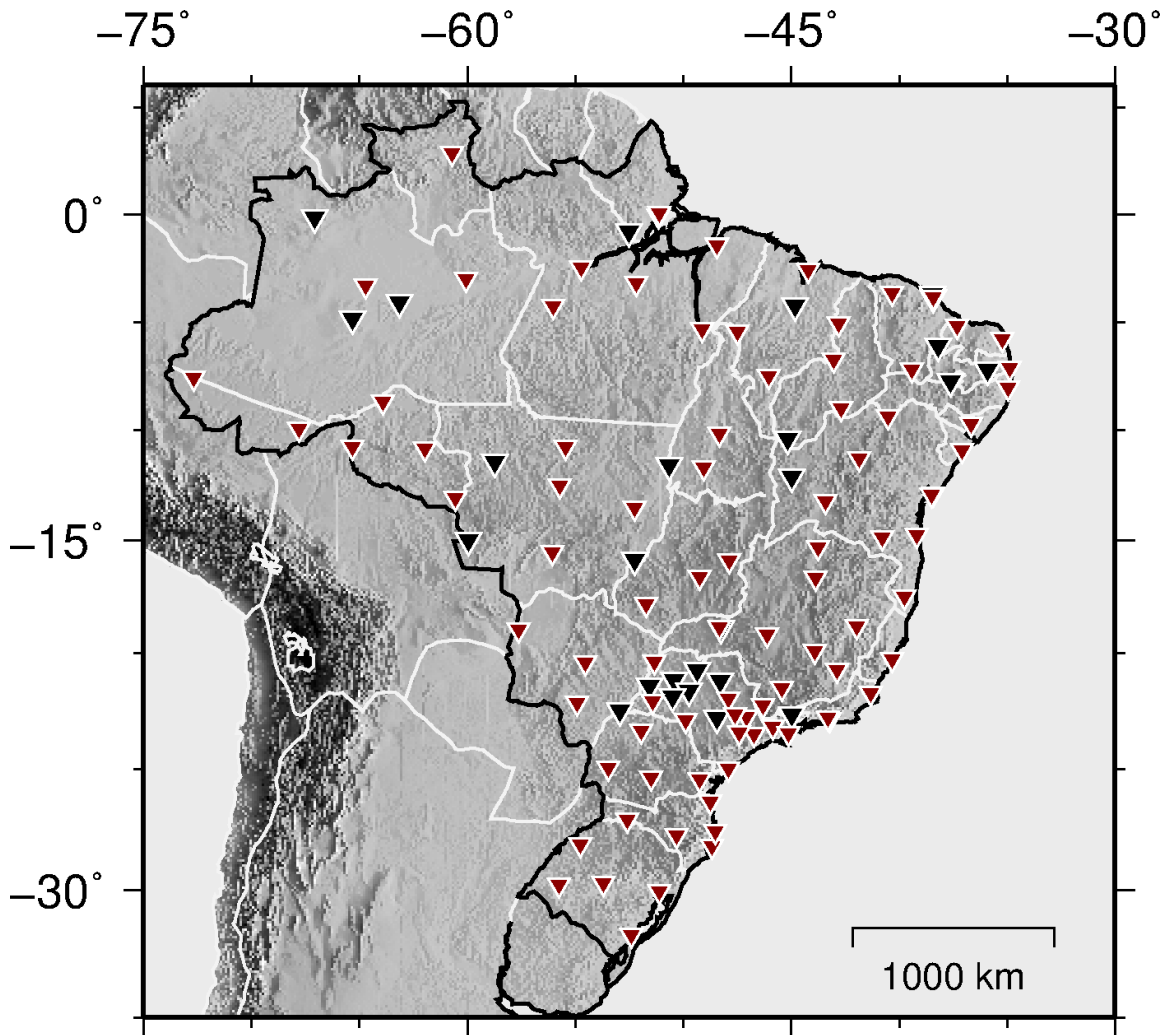
PEGBR – <http://www.pegbr.on.br/>

- Seismology
 - L4C – 1c + Texan → **365** u. (Short-Period)
 - L4C3D – 3c + RT130 → **60** u. (Short-Period)
 - STS-2 – 3c + Q330 → **11** u. (Broad-Band)
- Gravimetry
 - Scintrex CG-5 → **6** u.
- Magnetometry
 - Magnetometer + Gradiometer MMPOS-02 → **6** u.
- Geoelectric methods (Magnetotelluric and electric transient methods)
 - Magnetotelluric System with flux gate magnetometers + LEMI-417 and GPS → **18** u. (Short-Period)
 - Magnetotelluric System with induction coils MFS-06 + Metronix ADU-07 and GPS → **6** u. (Broad Band)
 - terraTEM Base System (transient Electromagnetic) → **2** u.
- GPS/GNSS
 - Trimble NetR8 + Antenas + Cable → **4** p.

+80
projects
supported in
Brazil until 2014

RBMC – GNSS stations

Rede Brasileira de Monitoramento Contínuo dos Sistemas GNSS

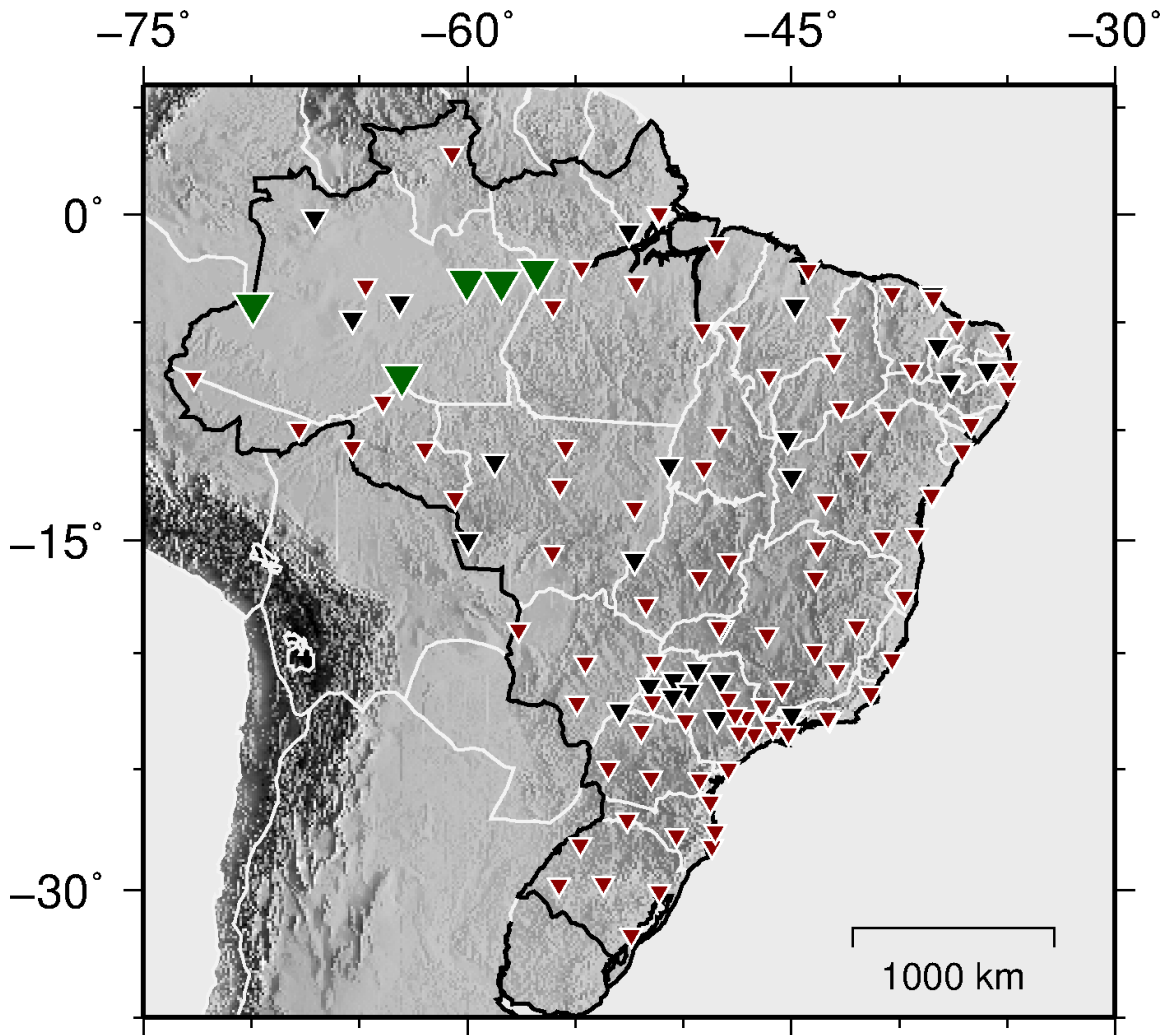


- ▼ Post-processing (Offline)
- ▼ Real-time processing (Online)

- IBGE – INPE + 40 institutions
- Total of 117 stations
 - 91 Online stations
 - 26 Offline – Post processing only stations
- Continuous data is shared with research institutions and universities

RBMC – GNSS stations

Rede Brasileira de Monitoramento Contínuo dos Sistemas GNSS



- ▼ Post-processing (Offline)
- ▼ Real-time processing (Online)

- Total of 117 stations
 - 91 Online stations
 - 26 Offline – Post processing only stations
- +5 stations in test for 2015 covering the north region
- +5 stations to be arranged in 2015

Station SJSP

SIPEG/RMBC Project – Installed by INPE



- Sampling interval is 15 seconds
- Daily data is shared using RINEX2 format
- Each station can reach a precision of ± 5 mm

SJSP report



RBMC - Rede Brasileira de Monitoramento Contínuo dos Sistemas GNSS
Relatório de Informação de Estação
SJSP - São José dos Campos

0. Formulário

Preparado por: Centro de Controle Eng. Kátia Duarte Pereira - RBMC
Data: 29/04/2013
Atualização: 10/03/2015 - Troca de equipamento

1. Identificação da estação GPS

Nome da Estação: SÃO JOSÉ DOS CAMPOS
Ident. da Estação: SJSP
Inscrição no Monumento: SAT 91537
Código Internacional: [91537](#)
Informações Adicionais: -

2. Informação sobre a localização

Cidade: São José dos Campos
Estado: São Paulo

Informações Adicionais: Pilar de concreto com formato cilíndrico, medindo 1,16 m de altura e com 0,29 m de diâmetro, está assentado em uma base de 1,00 m x 1,00 m x 0,80 m. Possui no topo um dispositivo de centragem forçada padrão UFRJ. Foi colocado a 0,20 m do topo, uma chapa de metal padrão IBGE na parte sudeste do marco, foi estampado: SAT- 91537. Próximo a uma cerca, a SE da portaria 1 do Instituto Nacional de Pesquisas Espaciais - INPE, na cidade de São José dos Campos - SP.

SJSP report

4. Informações do equipamento GNSS

4.1. Receptor

4.1.1	Tipo do Receptor	- TRIMBLE NETR8
	Número de Série	- 4923K35601
	Versão do Firmware	- 4.87 (Principal)
	Data de Instalação	- 10/03/2015 às 11:15 UTC

4.1.2	Tipo do Receptor	- TRIMBLE NETR8
	Número de Série	- 4923K35622
	Versão do Firmware	- 4.87 (Principal)
	Data de Instalação	- 27/02/2015 às 13:45 UTC
	Data de Remoção	- 10/03/2015 às 11:00 UTC

Data Sharing

- Online data sharing from **IBGE servers** using a NTRIP protocol
- Daily data for post-processing – user registration is advised
- Real-time data is restricted by 5 data flows / user – user registration is required
- Research Institutes and Universities have access to all data simultaneously

More Information

Web Address

- IBGE web-page: <http://www.ibge.gov.br/home/geociencias/geodesia/rbmc/rbmc.shtm>

Instituto Brasileiro de Geografia e Estatística

ENGLISH * ESPAÑOL

ACESSO À INFORMAÇÃO * LINKS * FALE CONOSCO * MAPA DO SITE

Google™ Pesquisa Personalizada

Pesquisar

Indicadores | População | Economia | **Geociências** | Canais | Download | Pesquisas | Sala de Imprensa

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
- ▶ PPP em tempo real
- ▶ Análise dos dados
- ▶ Cadastro e Renovação
- ▶ Parcerias

RBMC - Rede Brasileira de Monitoramento Contínuo dos Sistemas GNSS

Sobre a RBMC

A utilização da tecnologia GNSS (Global Navigation Satellite System) provocou uma verdadeira revolução nas atividades de navegação e posicionamento. Os trabalhos geodésicos e topográficos passaram a ser realizados de forma mais rápida, precisa e econômica. À medida que as técnicas de posicionamento evoluem, diversas aplicações em tempo real e pós-processado têm surgido, tornando o papel da RBMC cada vez mais amplo.

Nas aplicações geodésicas e topográficas do GNSS está implícita a utilização do método relativo, isto é, ao menos uma estação de coordenadas conhecidas é também ocupada simultaneamente à ocupação dos pontos desejados. As estações da RBMC desempenham justamente o papel do ponto de coordenadas conhecidas pertencentes ao Sistema Geodésico Brasileiro (SGB), eliminando a necessidade de que o usuário imobilize um receptor em um ponto que, muitas vezes, oferece grandes dificuldades de acesso. Além disso, os receptores que equipam as estações da RBMC são de alto desempenho, proporcionando observações de grande qualidade e confiabilidade.

Caracterização

As estações da RBMC são materializadas através de pinos de centragem forçada, especialmente projetados, e cravados em pilares estáveis. A maioria dos receptores da rede possui a capacidade de rastrear satélites GPS e GLONASS, enquanto alguns rastreiam apenas GPS. Esses receptores coletam e armazenam continuamente as observações do código e da fase das ondas portadoras transmitidos pelos satélites das constelações GPS ou GLONASS.

Cada estação possui um receptor e antena geodésica, conexão de Internet e fornecimento constante de energia elétrica que possibilita a operação contínua da estação.

As coordenadas das estações da RBMC são outro componente importante na composição dos resultados

Veja mais

- ▶ Parcerias

Marcelo Bianchi¹, Bruno Collaço², Felipe Neves¹

¹Instituto de Astronomia Geofísica e Ciências Atmosféricas (IAG) / ²Instituto de Energia e Ambiente (IEE)

* Contact: m.bianchi@iag.usp.br / sismologia@iag.usp.br

Brazilian Seismic Bulletin

Earthquakes with magnitude close to 3 m_b are routinely detected and considered medium sizes while earthquakes magnitude 4 and above are considered large (Figure 1). Largest Brazilian earthquake was the 1955 Serra do Tombador with magnitude 6.2 m_b .

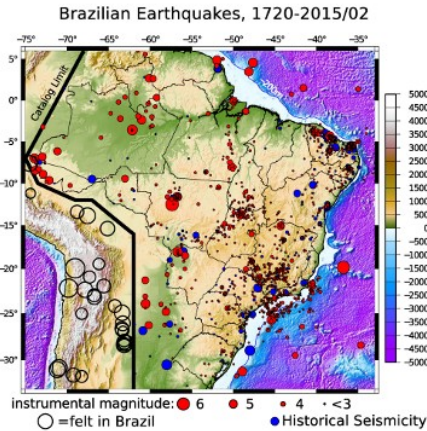


Figure 1: Joint Brazilian Seismic Bulletin (BSB) of detected and felt earthquakes results from more than 30 years of joint work of different institutions (University, Companies and Individuals) in Brazil.

Brazilian Seismographic Network (RSBR)

Brazilian main network operators are (flags in Figure 2):

- Observatório Nacional (ON), Rio de Janeiro, RJ
- Universidade de Brasília (UnB), Brasília, DF
- Universidade Federal do Rio Grande do Norte (UFRN), Natal, RN
- Universidade de São Paulo (USP), São Paulo, SP

These 4 institutions have installed and operates 82 open data real-time stations part of the Brazilian Seismographic Network (RSBR) since 2009.

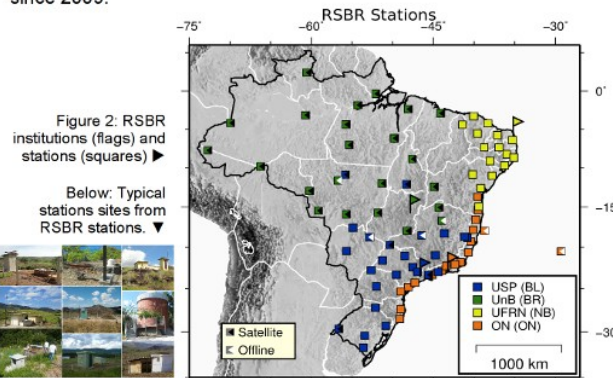


Figure 2: RSBR institutions (flags) and stations (squares)

Below: Typical stations sites from RSBR stations.



Data Flow Overview

The main processing tasks are done by a SeisCompP3 system (Sc3). We keep different installations of Sc3 tuned for each task. BRASIS stations are received by Nanometrics Apollo Server and others by SeedLink chain plug-ins. Data is stored into 3 different SDS (named NRT, Intermediate and Permanent) fed as indicated in Figure 4.

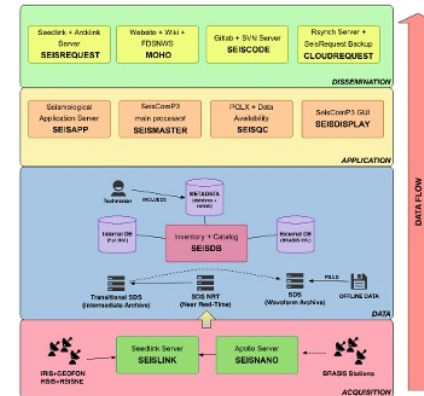


Figure 3: USP datacenter subdivision layers from acquisition to dissemination of data and results.

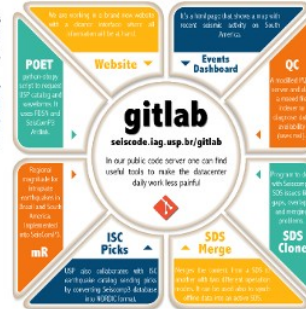
All data is secured in two separated stores, a local and a cloud storage provided by the University.

Interaction with processes are done remotely from individual analysts desktops.

Data Management home-made tools

Figure 4: Set of tools developed in-house and available in our GitLab Server.

Some are specifically designed to fulfill our internal needs but are also used by other RSBR nodes.



Data Products & More

Summer School



Open lectures to students, company employees and general public.

Main Topics:
Introduction to Seismology
Surface Waves Analysis
ObsPy: Python for Seismologists
Usage of GMT tools

Open Lab Day and Community Work

The center actively participate in different activities to spread the seismological knowledge inside and outside the University.

Activities includes:
Field experiments and informal talks to the people;
News Interviews;
Local communities visits to the center dependencies;



Relevant Scientific Publications



USP Datacenter Team



Useful URLs

- Web Pages:**
- www.sismo.iag.usp.br :: USP Website
 - www.seiscode.iag.usp.br/gitlab :: USP GitLab
 - www.rsis1.on.br :: ON Node Website
 - www.obsis.unb.br :: UnB Node Website
 - www.rgsbr.org.br :: RSBR Main Server

- Data Servers:**
- seisrequest.iag.usp.br:18000 :: USP Seedlink Server
 - seisrequest.iag.usp.br:18001 :: USP Arclink Server

- Federated Server:**
- www.moho.iag.usp.br/fdsnws :: USP Federated FDSNws Server



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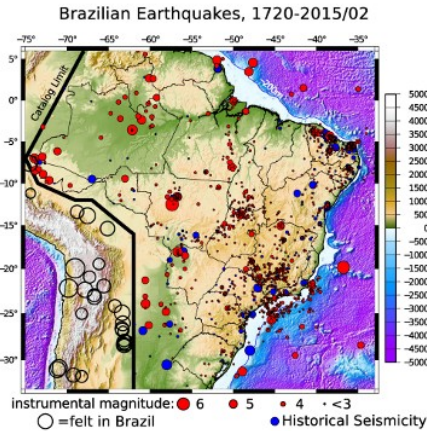


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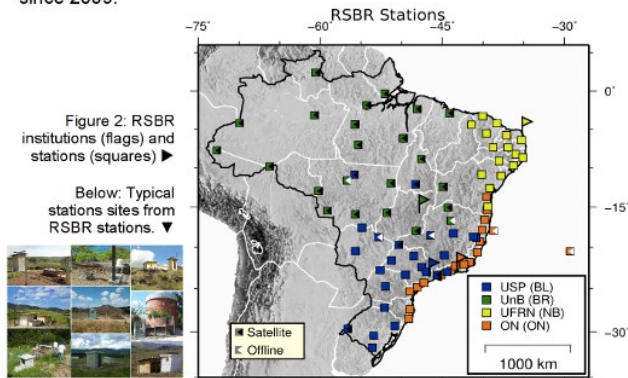
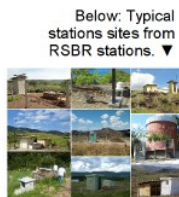


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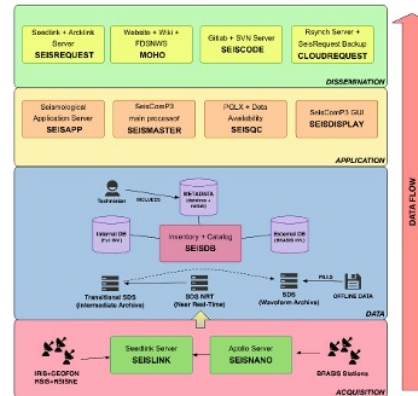


Figure 3: USP datacenter subdivision layers from acquisition to dissemination of data and results.

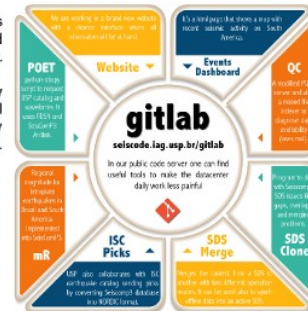
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LINKS !!!

Get all RSBR / USP important URL encoded + a link to this presentation and the poster PDFs to take home !

Useful URLs

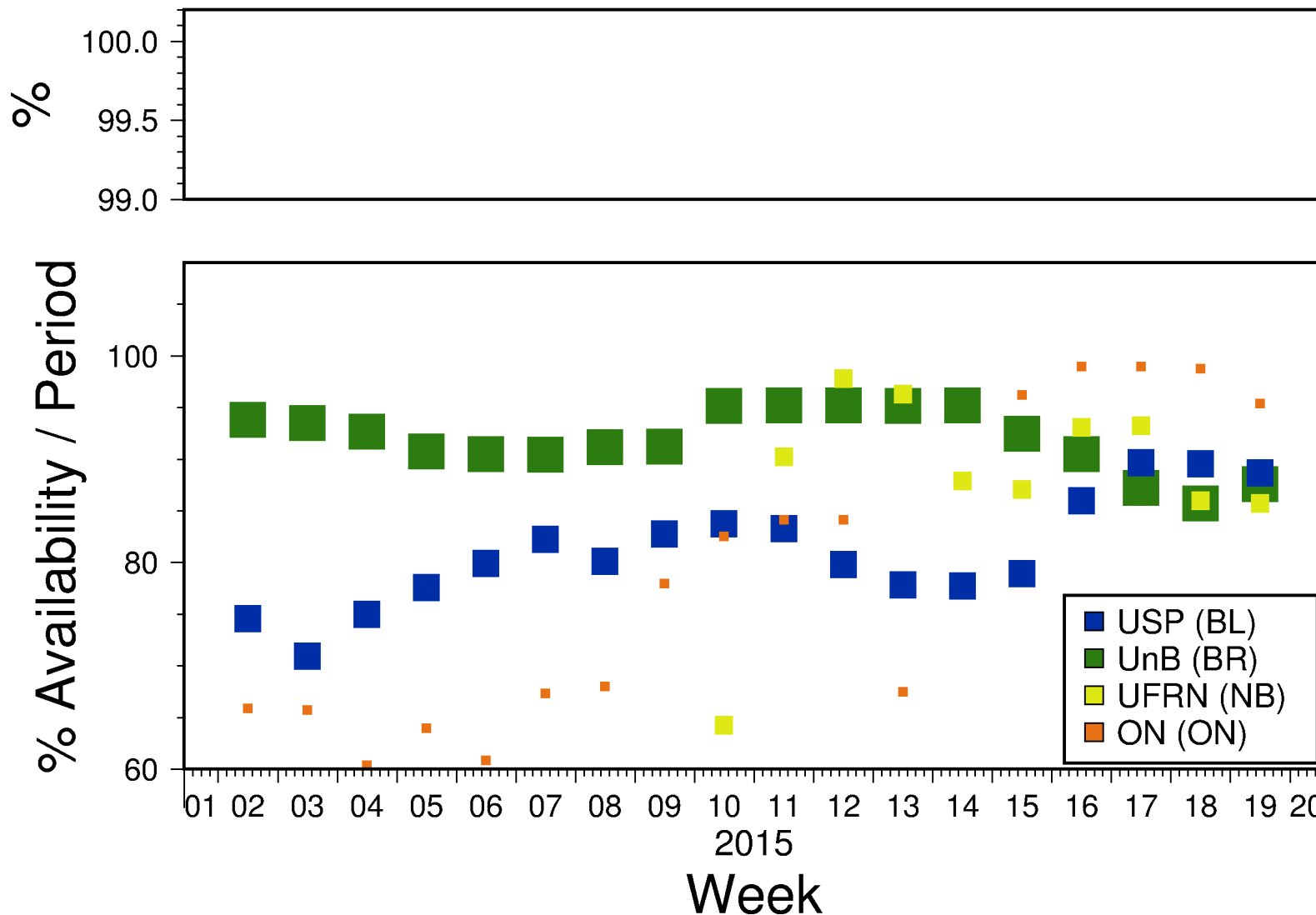
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 - www.seiscode.iag.usp.br/gitlab :: USP GitLab
 - www.rsis1.on.br :: ON Node Website
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Thank You !

Near Real-time Availability

mean weekly



- % Availability per Network (MEAN station channels) in a 7 days week as NRT archived by USP data center;
- Mean vs median values shows that problems are localized in individual stations.
- Amount of data in archive depends still on regular maintenance of stations in the field !