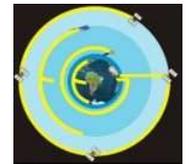


A integração do Projeto Temático GNSS-SP com os projetos CALIBRA e CIGALA

Bruno César Vani – brunovani22@gmail.com

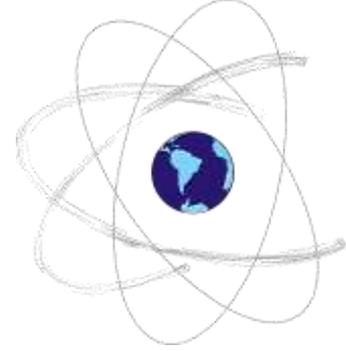
Prof. Dr. Milton Hirokazu Shimabukuro – miltonhs@fct.unesp.br

Prof. Dr. João Francisco Galera Monico – galera@fct.unesp.br

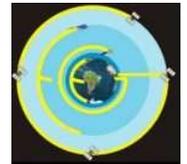


Conteúdo

- Projeto CIGALA
- Projeto CALIBRA
- Infraestrutura de Monitoramento
- Infraestrutura de Análise
 - ISMR Query Tool
- Perspectivas futuras e Considerações Finais



Concept for Ionospheric Scintillation Mitigation for Professional GNSS in Latin America





European GNSS Supervisory Authority

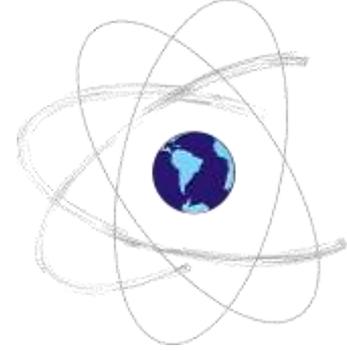
- Financiado pela European Commission (EC) no âmbito do FP7-GALILEO-2009-GSA (European GNSS Agency)
- Objetivos:
 - analisar os efeitos da cintilação
 - compreender suas causas
 - desenvolver novas técnicas de contra medidas a serem implementadas em receptores GNSS



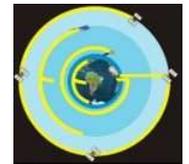
- Equipe:



Istituto Nazionale di Geofisica e Vulcanologia



Countering GNSS high Accuracy applications Limitations due to Ionospheric disturbances in BRAzil





- Atenuação das Limitações nas Aplicações GNSS de Alta Acurácia devido aos Distúrbios Ionosféricos no Brasil
- Foi submetido dentro da chamada FP7–GALILEO–2011–GSA–1a, realizada pela ESA (European Space Agency).

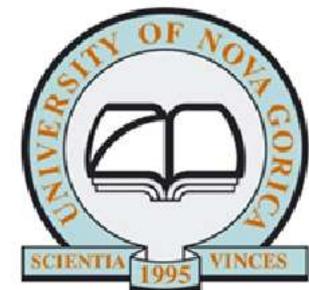


- **Objetivos principais:**
 - melhorar os algoritmos existentes e desenvolver novos com o objetivo de mitigar os efeitos causados por distúrbios da ionosfera no posicionamento GNSS de alta precisão

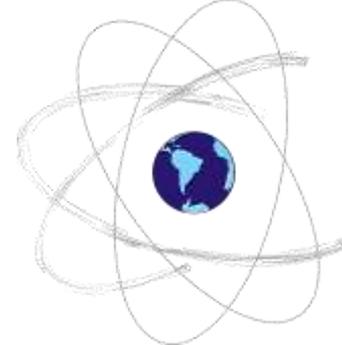
- Identificação de como as observações e os algoritmos existentes são degradados pelos fenômenos relacionados com a ionosfera, avaliando o impacto no RTK, WARTK e PPP em termos de acurácia, integridade e disponibilidade.
 - Serão desenvolvidos métodos de mitigação baseados nas evidências experimentais.



- Equipe



20/06/2013

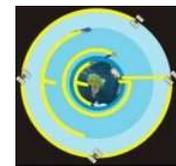


Infraestrutura de Monitoramento

Integração dos Projetos CIGALA,
CALIBRA e GNSS-SP



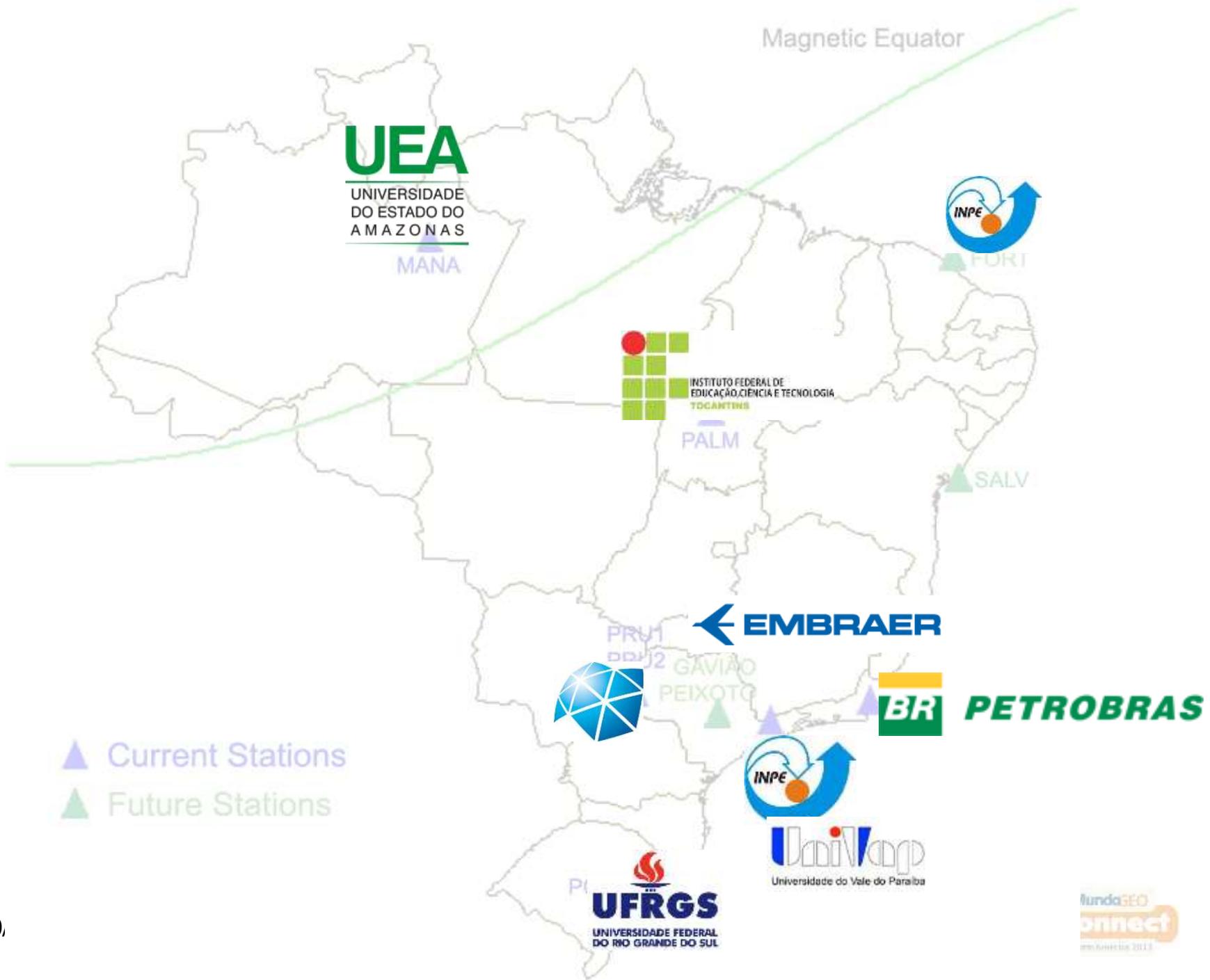
20/06/2013



Estações de Monitoramento

- Receptores que proveem índices de cintilação, parâmetros da ionosfera e dos sinais GNSS
 - S4 (amplitude)
 - Sigma-phi (phase)
 - TEC
 - Locktime

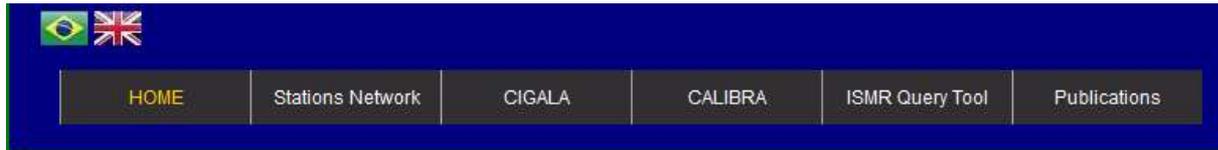




Estações Experimentais

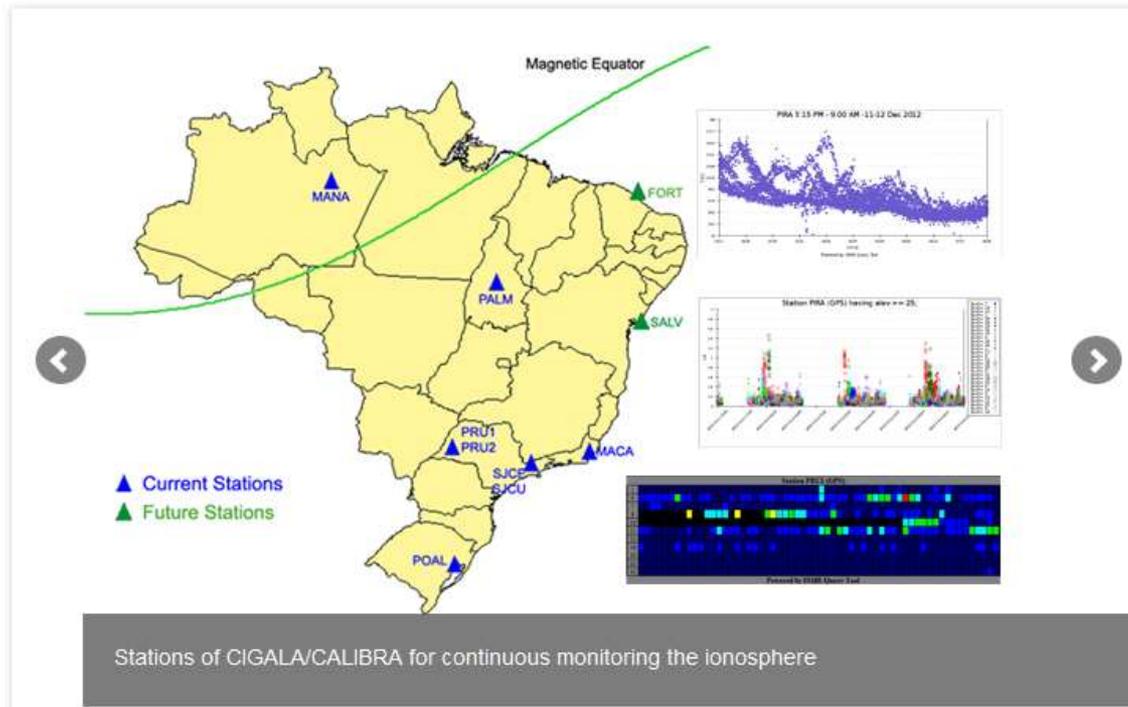


<http://is-cigala-calibra.fct.unesp.br>



New web portal available!

Following the news on CALIBRA Project and ISMR Query Tool!

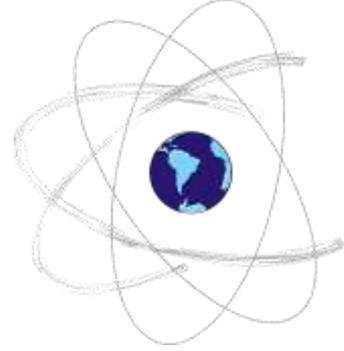


20/06/2013



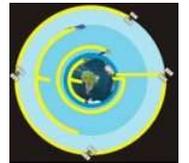
Características da Base de Dados

- As primeiras estações foram estabelecidas em Fevereiro/2011 em P. Prudente
- Mais de 13 TB de dados
- Aprox. 7,5bi de registros de monitoramento
- Atualmente, 10 estações estão coletando continuamente, sendo 8 fixas e 2 experimentais
- Com o Projeto CALIBRA, existe a previsão de instalação de mais 5 estações pelo território Brasileiro

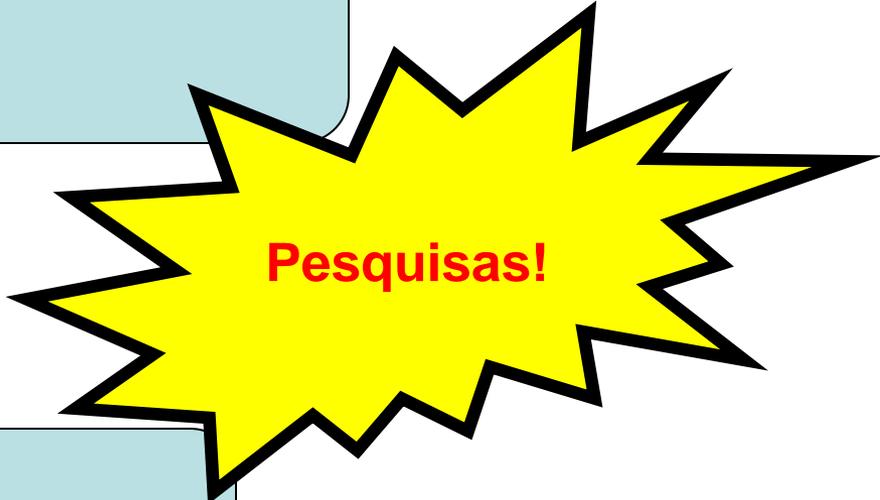
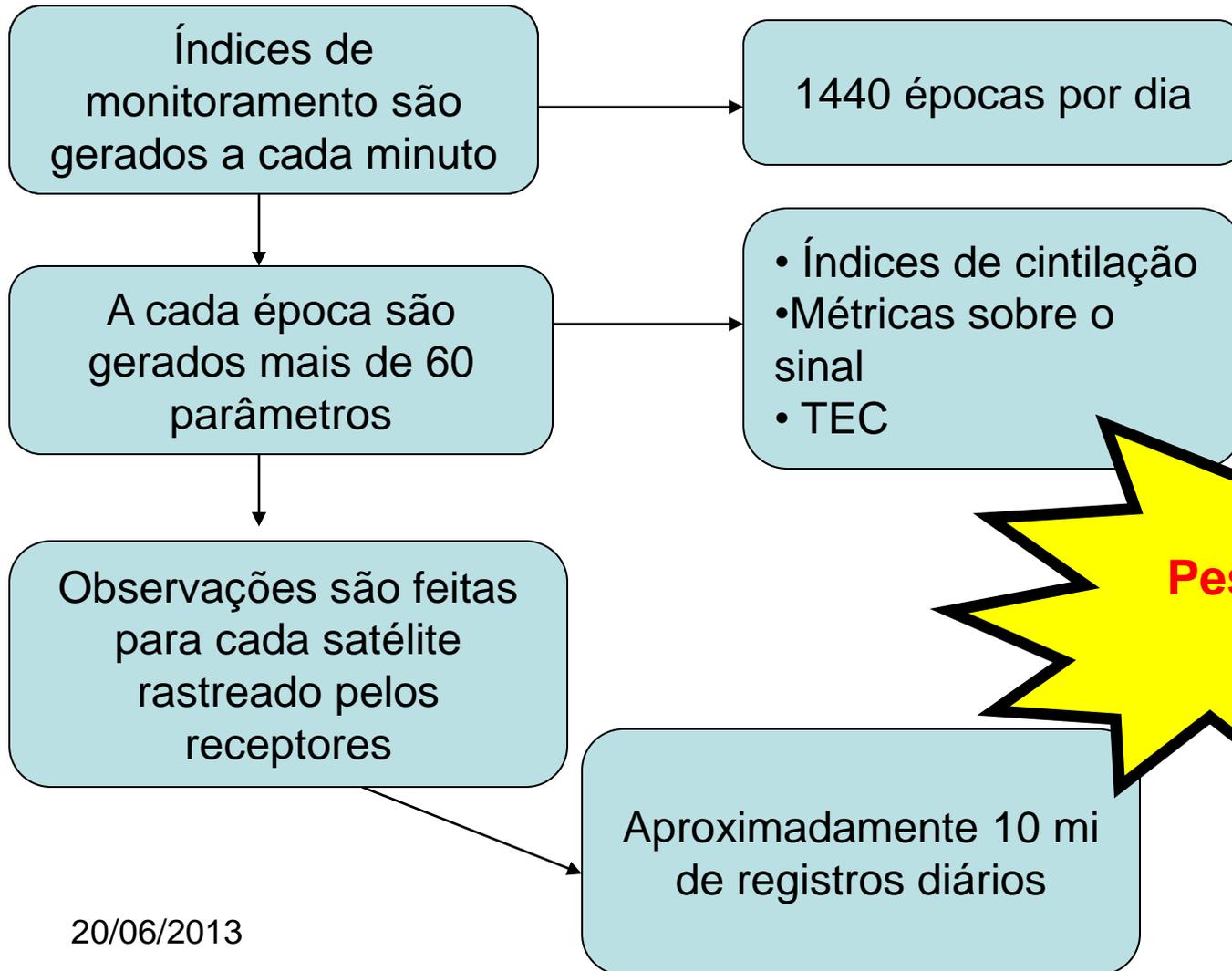


Infraestrutura de Análise

ISMR Query
Tool



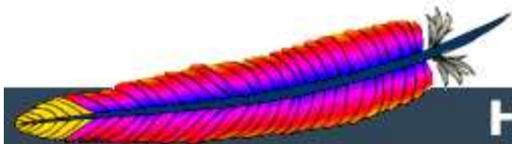
Observações de Monitoramento



Lidando com grande volume de dados

- Como encontrar comportamentos específicos?
- Ex:
 - Encontrar períodos de disponibilidade ameaçada (poucos satélites e incidência de forte cintilação)
 - Comparar globalmente a incidência em satélites modernos x antigos

ISMR Query Tool



Apache
HTTP SERVER PROJECT



MapServer
open source web mapping

PostgreSQL



PostGIS



JAVA
SCRIPT

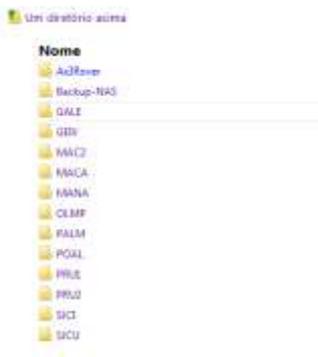
jQuery
write less, do more.

ISMR Data



OLMP033A.12_ismr

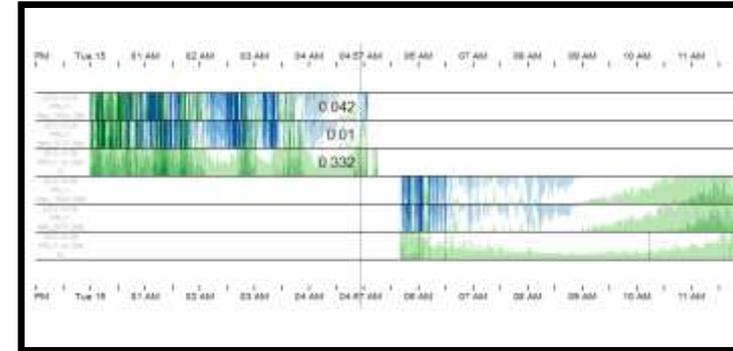
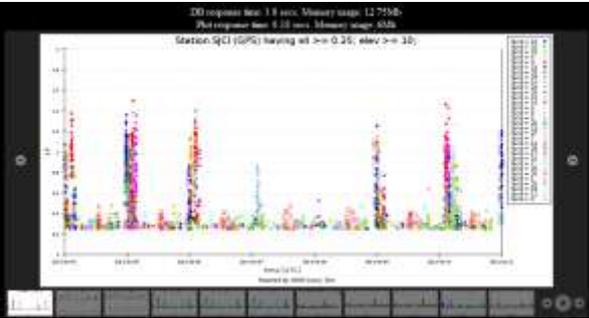
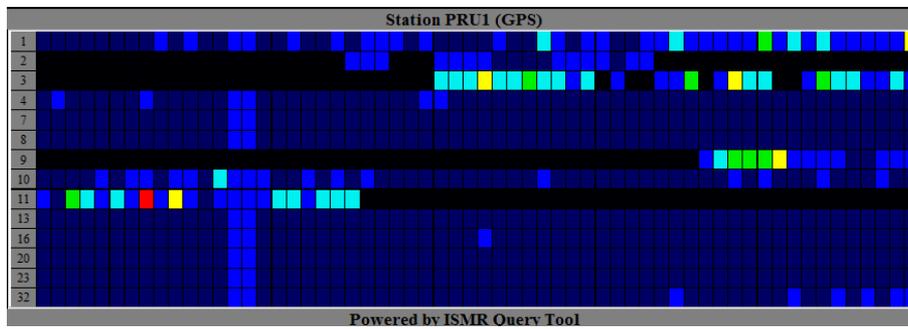
1	1673,345660, 25,	628, 17,	5,41.3,	0.208,	0.087,	0.037,	0.053,	0.069,	0.070,	0.072,	-3.123,	0.300,	44.773,	0.008,	53.312,	0.124,	6
2	1673,345660, 15,	628,117,	20,44.7,	0.075,	0.059,	0.022,	0.026,	0.029,	0.030,	0.030,	-35.347,	0.140,	68.179,	-0.064,	66.656,	-0.049,	6
3	1673,345660, 30,	628,277,	42,47.2,	0.995,	0.044,	0.264,	0.453,	0.640,	0.668,	0.668,	-15.494,	1.394,	nan,	nan,	nan,	nan,	6
4	1673,345660, 6,	628,217,	27,42.9,	0.531,	0.072,	nan,	nan,	nan,	nan,	nan,	-18.169,	0.187,	68.860,	0.267,	72.154,	-0.464,	6
5	1673,345660, 22,	628,308,	60,48.8,	0.878,	0.036,	0.432,	0.862,	1.323,	1.347,	1.390,	-17.690,	0.499,	82.205,	1.013,	77.188,	-1.857,	6
6	1673,345660, 18,	628,155,	70,49.7,	0.071,	0.033,	0.018,	0.023,	0.027,	0.027,	0.028,	-17.724,	0.077,	63.470,	0.023,	66.497,	0.021,	6
7	1673,345660, 51,	628,288,	2,37.7,	0.302,	0.131,	0.047,	0.056,	0.063,	0.063,	0.063,	-5.157,	0.442,	116.384,	-0.106,	119.353,	-0.073,	12
8	1673,345660, 29,	628, 68,	38,46.6,	0.111,	0.047,	0.023,	0.027,	0.032,	0.032,	0.032,	11.040,	0.309,	97.503,	0.376,	95.666,	0.373,	9
9	1673,345660, 21,	628,153,	43,47.8,	0.042,	0.041,	0.016,	0.019,	0.022,	0.023,	0.023,	-6.115,	0.092,	59.655,	0.048,	57.199,	0.047,	5
10	1673,345660, 14,	628, 0,	12,38.6,	0.544,	0.117,	0.125,	0.224,	0.296,	0.303,	0.304,	-3.410,	0.323,	28.168,	0.661,	33.890,	0.574,	3
11	1673,345660, 3,	628,220,	16,41.4,	0.259,	0.085,	0.027,	0.029,	0.032,	0.032,	0.032,	-4.365,	0.258,	95.785,	-0.000,	90.597,	0.034,	8
12	1673,345660, 59,	628, 57,	3,37.2,	0.874,	0.138,	0.078,	0.136,	0.215,	0.222,	0.222,	9.787,	0.602,	162.602,	2.134,	138.207,	0.436,	14
13	1673,345660,120,	628, 62,	45,42.7,	0.308,	0.073,	0.178,	0.377,	0.596,	0.622,	0.624,	3.161,	0.733,	nan,	nan,	nan,	nan,	4
14	1673,345660, 81,	628, 0,	0,50.5,	0.051,	0.030,	nan,	nan,	nan,	nan,	nan,	1.210,	3.084,	nan,	nan,	nan,	nan,	4
15	1673,345660, 31,	628,325,	1,38.3,	0.545,	0.121,	nan,	nan,	nan,	nan,	nan,	0.405,	0.259,	42.599,	0.011,	44.636,	-0.230,	4
16	1673,345660, 38,	628,156,	71,50.5,	0.031,	0.030,	0.018,	0.037,	0.060,	0.063,	0.063,	-17.815,	0.091,	81.637,	0.014,	78.827,	0.006,	7
17	1673,345660, 60,	628, 94,	43,48.8,	0.111,	0.036,	0.021,	0.043,	0.066,	0.068,	0.069,	-2.827,	0.192,	99.605,	0.064,	100.397,	0.058,	10
18	1673,345660, 16,	628,242,	34,46.1,	0.474,	0.049,	0.108,	0.245,	0.322,	0.337,	0.338,	-13.980,	0.490,	42.044,	1.398,	41.978,	1.193,	4
19	1673,345660,138,	628,282,	21,41.2,	0.425,	0.087,	nan,	nan,	nan,	nan,	nan,	-0.047,	0.994,	nan,	nan,	nan,	nan,	4
20	1673,345660, 54,	628,215,	6,39.1,	0.206,	0.111,	0.046,	0.072,	0.081,	0.082,	0.082,	-0.347,	0.624,	100.076,	-0.048,	97.954,	-0.192,	9



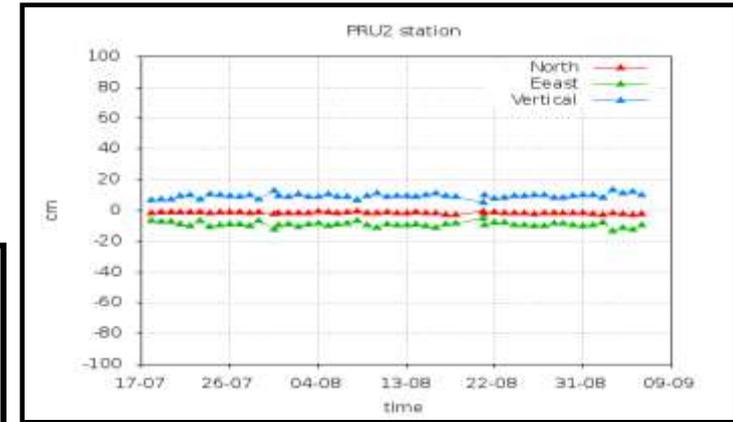
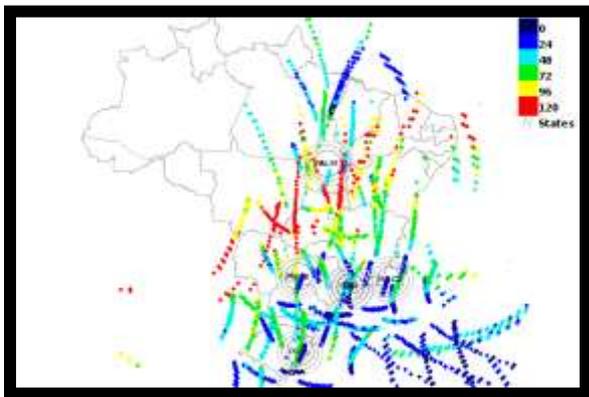
Características

ISMR Query
Tool

- Software como um Serviço on-line
- Aplicação de Técnicas de Visualização e Mineração de dados
 - Permite o Monitoramento da Ionosfera no Brasil
 - Suporte à análise dos dados
 - Descoberta de novas hipóteses
 - Apoio no desenvolvimento de técnicas de mitigação dos efeitos causados pela ionosfera no Posicionamento GNSS



ISMR Query Tool



20/06/2013

Interface web: <http://is-cigala-calibra.fct.unesp.br>

brunovani
Logout

HOME Rede de Estações CIGALA CALIBRA ISMR Query Tool Publicações Admin

Date/time interval	2013-06-17 00:00	2013-06-17 23:59	X-Axis / Label	Continuous Time	time (UTC)
Station(s)	PRU2		(Plot 1) Y-Axis / Label	s4	s4
Satellite(s)	GPS		(Plot 2) Y-Axis / Label	off	
S4	>=	and	Size & Color	600 x 300	Change Color
Elevation angle	>=	and	Title	Station PRU2 (GPS)	
phi6011	>=	and	Footer text	Powered by ISMR Query Tool	
(Custom Filters)	Empty		<input type="button" value="Plot"/> <input type="button" value="Clear all Images"/> <input type="button" value="Reset Filters"/>		

DB response time: 0.1 secs. Memory usage: 11Mb
Plot response time: 0.29 secs. Memory usage: 14.75Mb

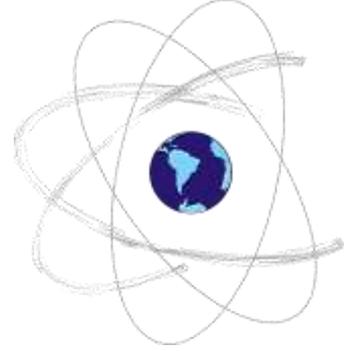
Station PRU2 (GPS)

s4

time (UTC)

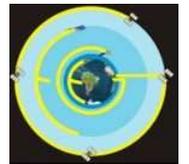
Powered by ISMR Query Tool

2



ISMR Query Tool

Exemplos



Selecionar e Filtrar dados

Query & View Rinex Time Converter GNSS Calendar My Profile Manual Logout Admin

Date/time interval	2013-02-20 00:00	2013-02-20 23:59
Station(s)	POAL , PRU1	
Satellite(s)	GPS, GLONASS	
S4	>=	and
Elevation angle	>=	10 and
phi6011	>=	and +
Empty		

X-Axis / Label	Continuous Time	time (UTC)
(Plot 1) Y-Axis / Label	s4	s4
(Plot 2) Y-Axis / Label	off	
Size & Color	800 x 400	Sort by Colors Change Color
Title	POAL,PRU1 (GPS,GLONASS) having elev >= 10:	
Footer text	Powered by ISMR Query Tool	

Plot Clear all Images Reset Filters

- phi6011
- avgcod_11
- sigmaccd_11
- tec_45
- dtec_6045
- tec_30
- dtec_4530
- tec_15
- dtec_3015
- tec
- dtec_15tow
- I1_locktime

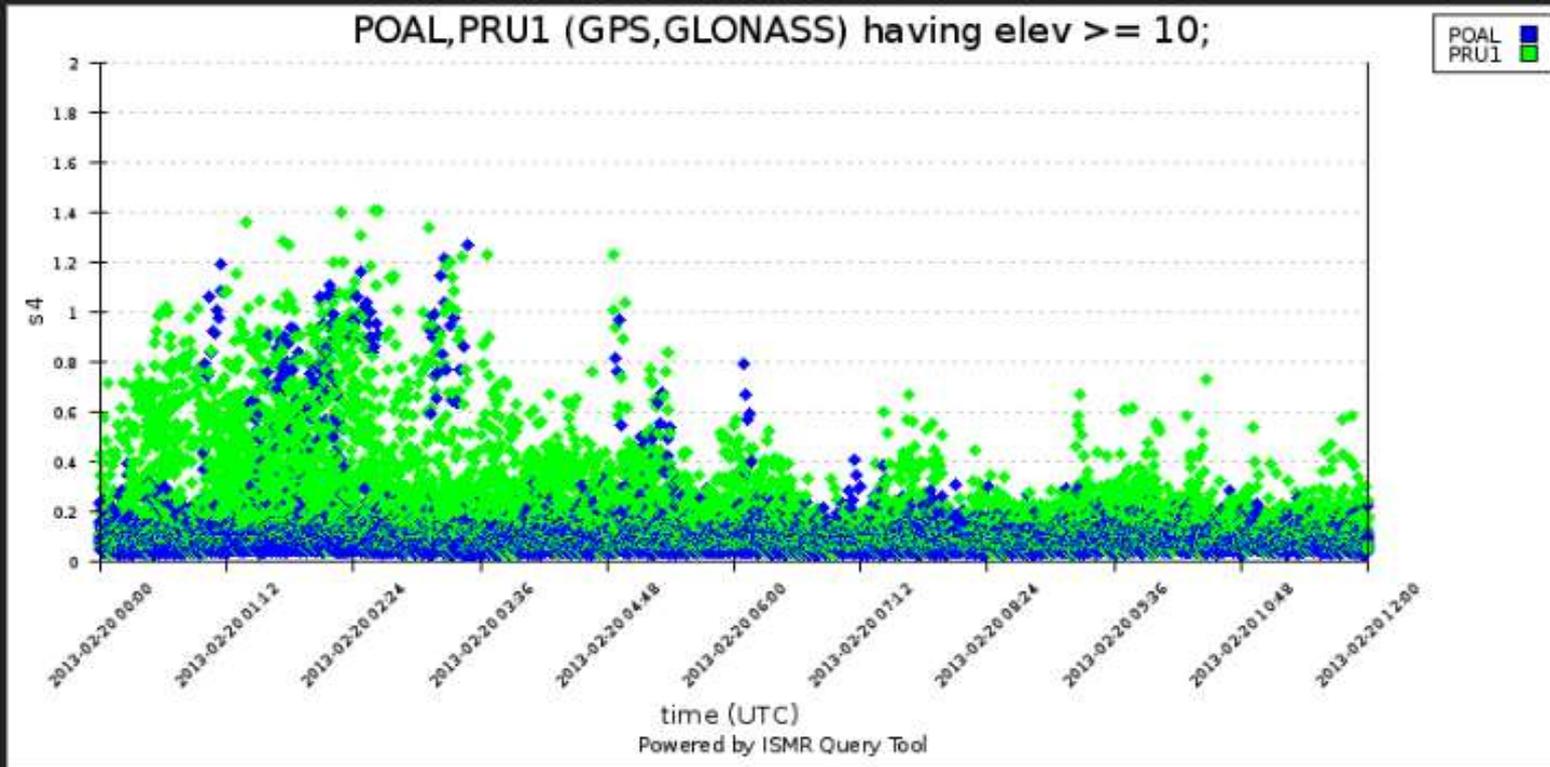
20/06/2013

Visualização em Gráficos sob demanda

DB response time: 0.48 secs. Memory usage: 55.75Mb

Plot response time: 1.13 secs. Memory usage: 16Mb

POAL,PRU1 (GPS,GLONASS) having elev ≥ 10 ;



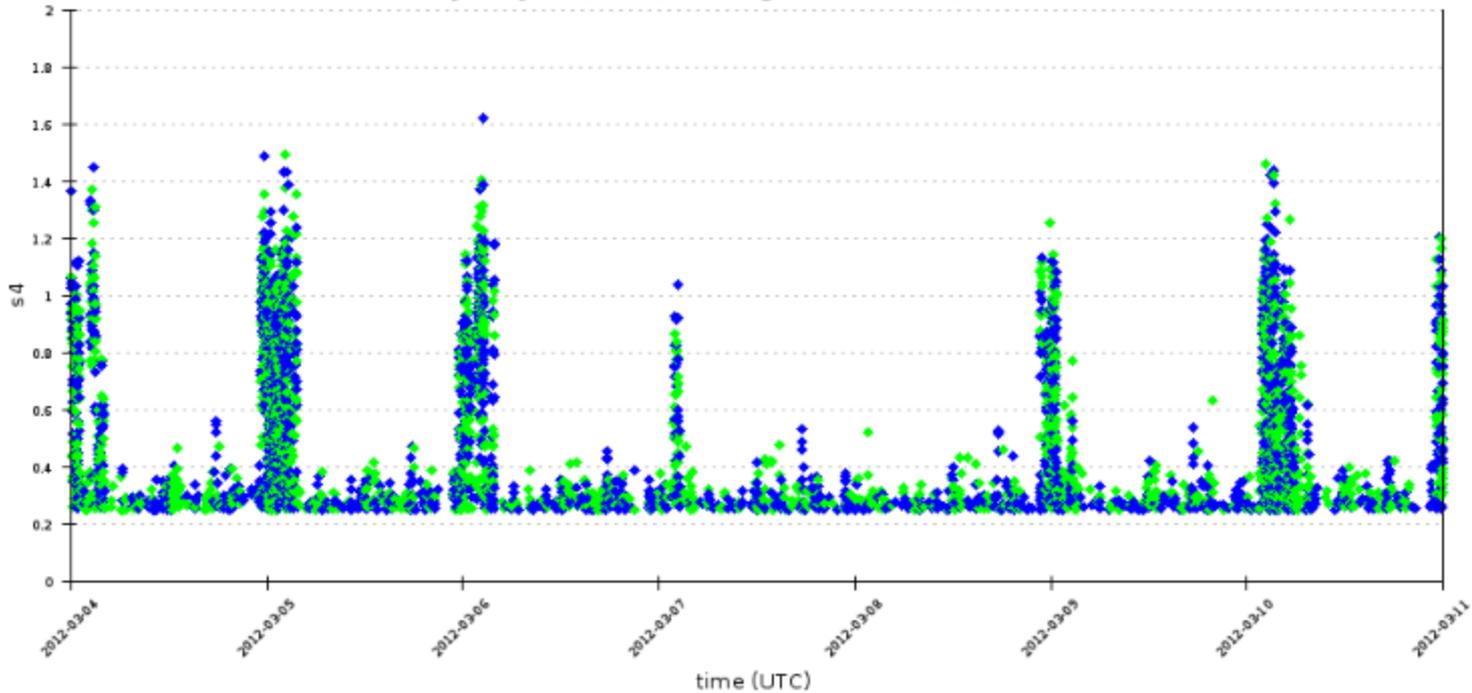
Exemplo – Picos em uma Semana

DB response time: 40.8 secs. Memory usage: 13.5Mb

Plot response time: 0.2 secs. Memory usage: 5Mb

SJCI,SJCU (GPS) having s4 >= 0.25; elev >= 10;

SJCU
SJCI



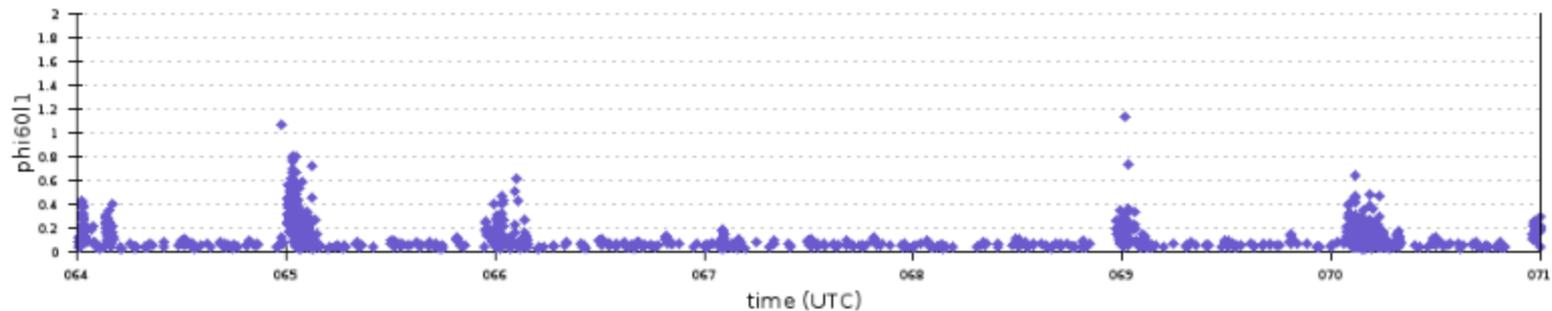
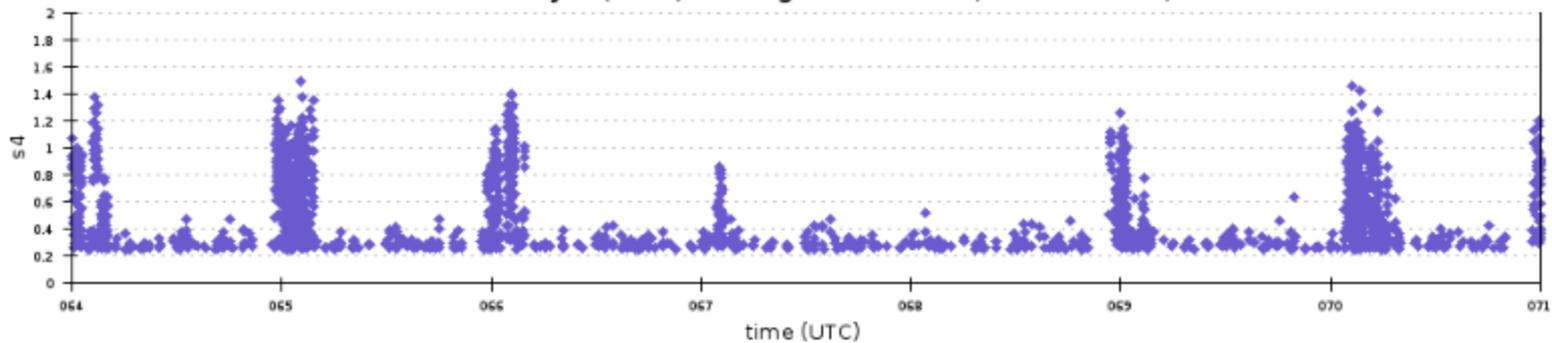
Powered by ISMR Query Tool

Exemplo – Comparação de Índices

DB response time: 9.1 secs. Memory usage: 8.75Mb

Plot response time: 0.18 secs. Memory usage: 4Mb

Station SJCI (GPS) having s4 \geq 0.25; elev \geq 10;



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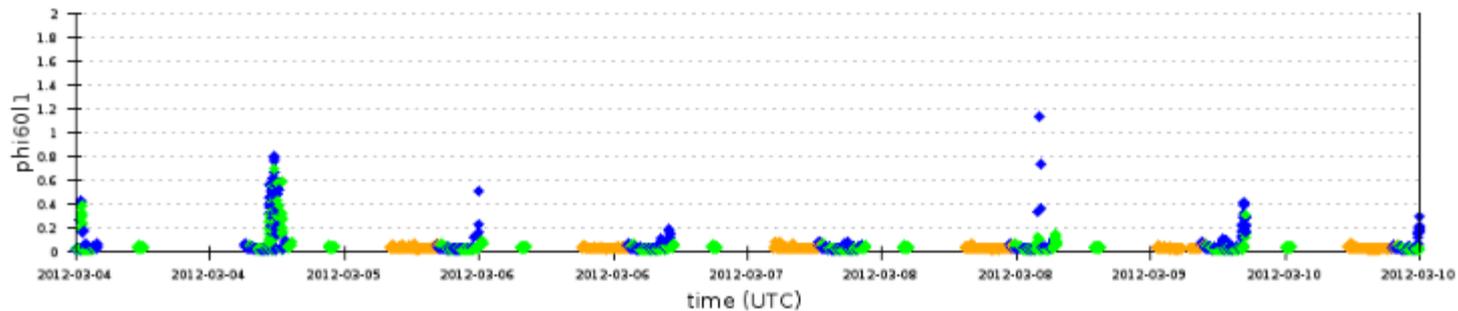
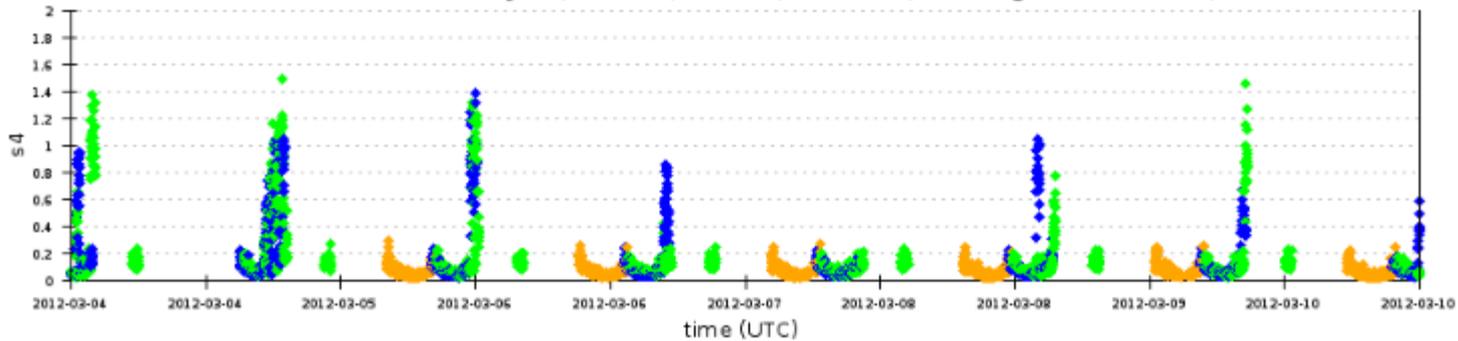
Identificação de Satélites

DB response time: 4.1 secs. Memory usage: 28.25Mb

Plot response time: 0.61 secs. Memory usage: 6.5Mb

Station SJCI (SVID 3,SVID 6,SVID 25) having elev ≥ 10 ;

Svid = 6
Svid = 3
Svid = 25

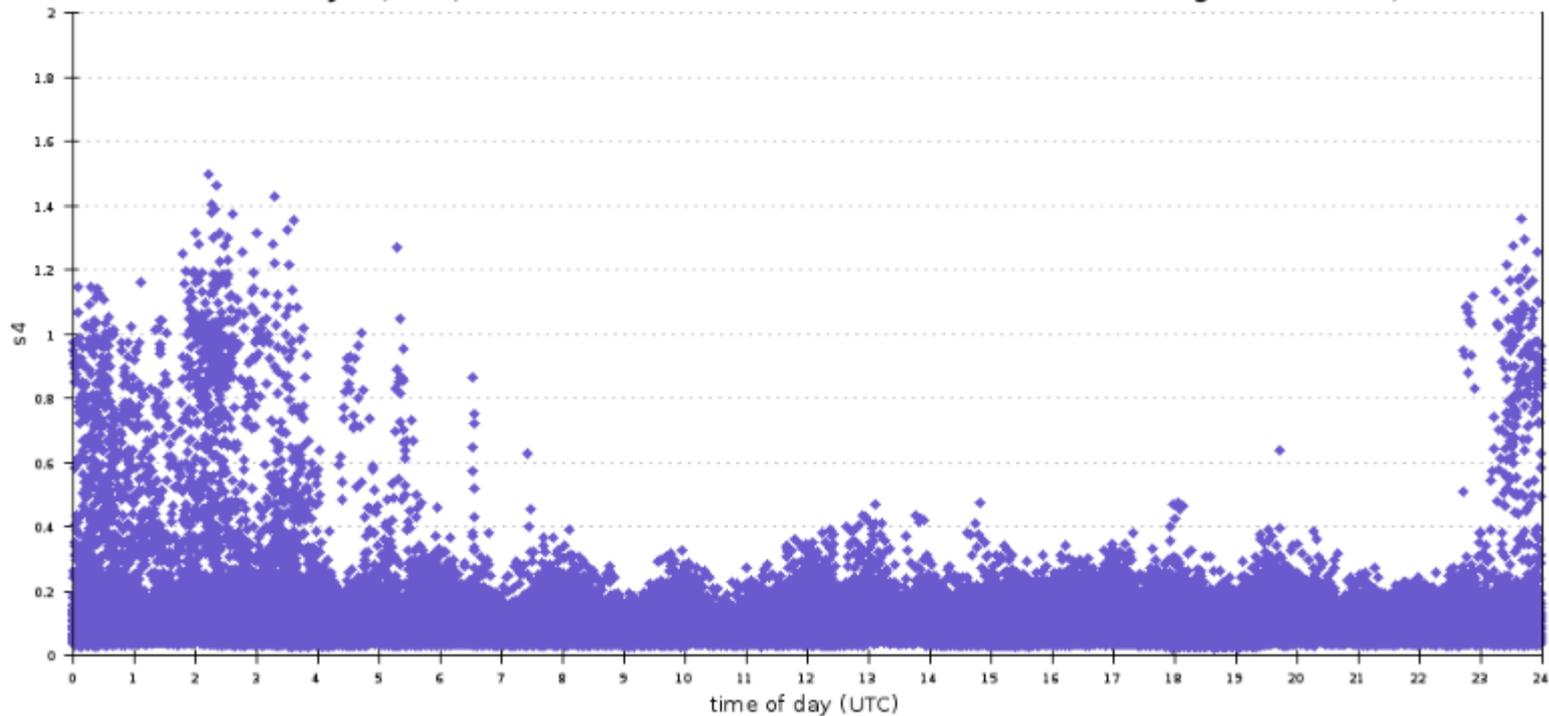


Powered by ISMR Query Tool

Horários mais afetados do dia

DB response time: 4.32 secs. Memory usage: 111.5Mb
Plot response time: 5.37 secs. Memory usage: 148.25Mb

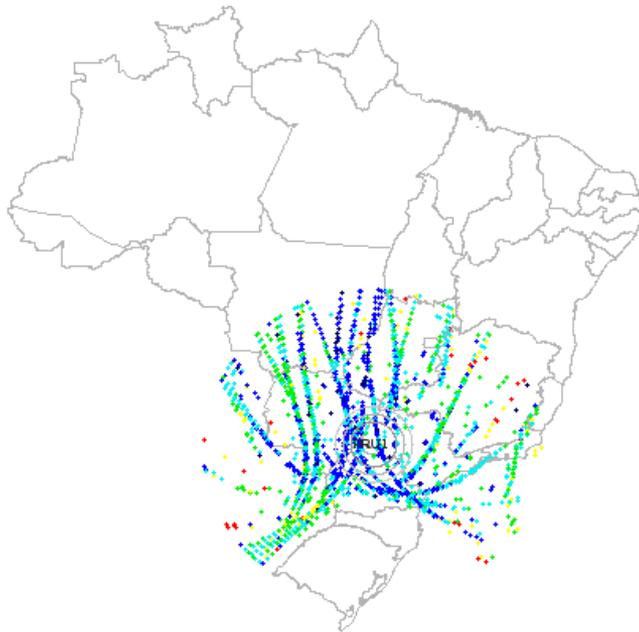
Station SJCI (GPS) - 2012-03-04 00:00 to 2012-03-10 23:59 - having elev ≥ 10 ;



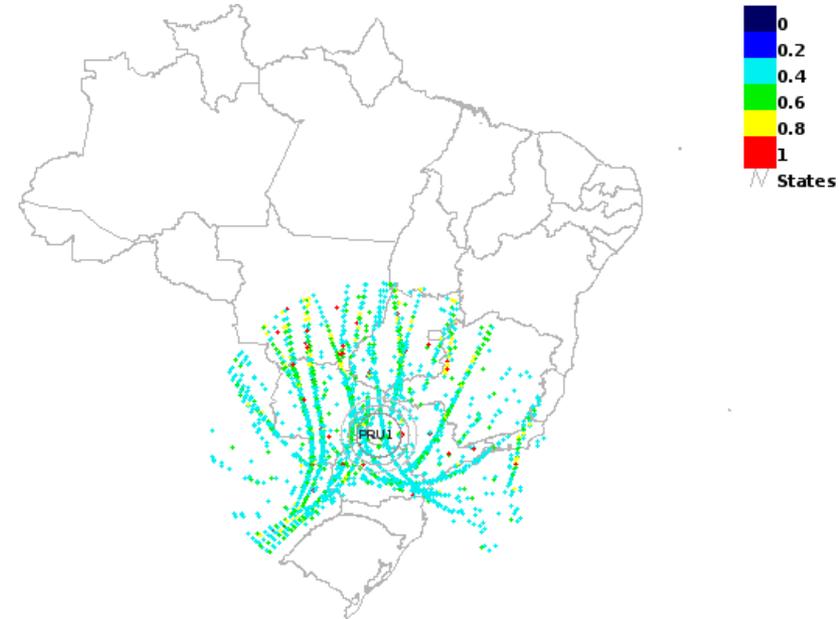
Powered by ISMR Query Tool



Mapas: S4, TEC, etc.



TEC from PRU1 – Jan/2012



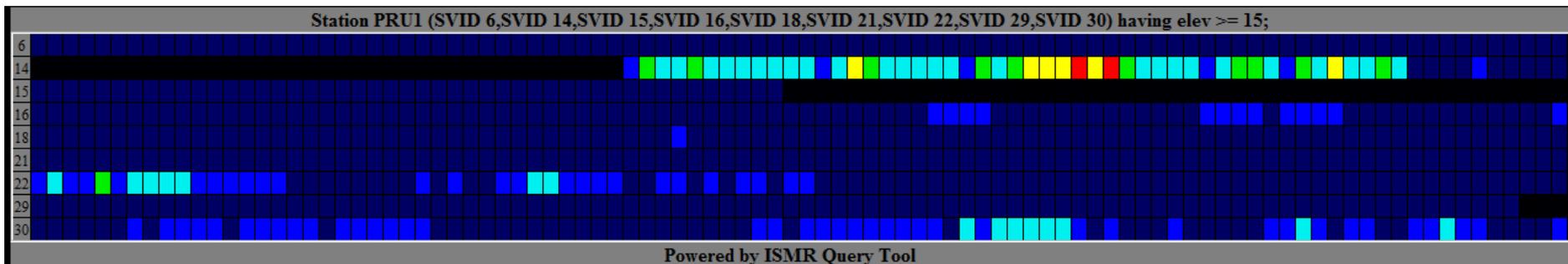
S4 from PRU1 – Jan/2012

S4 Map

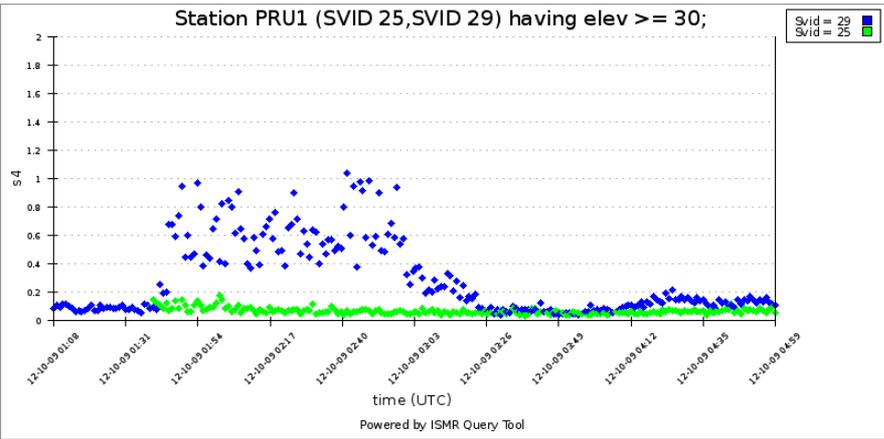


Grids

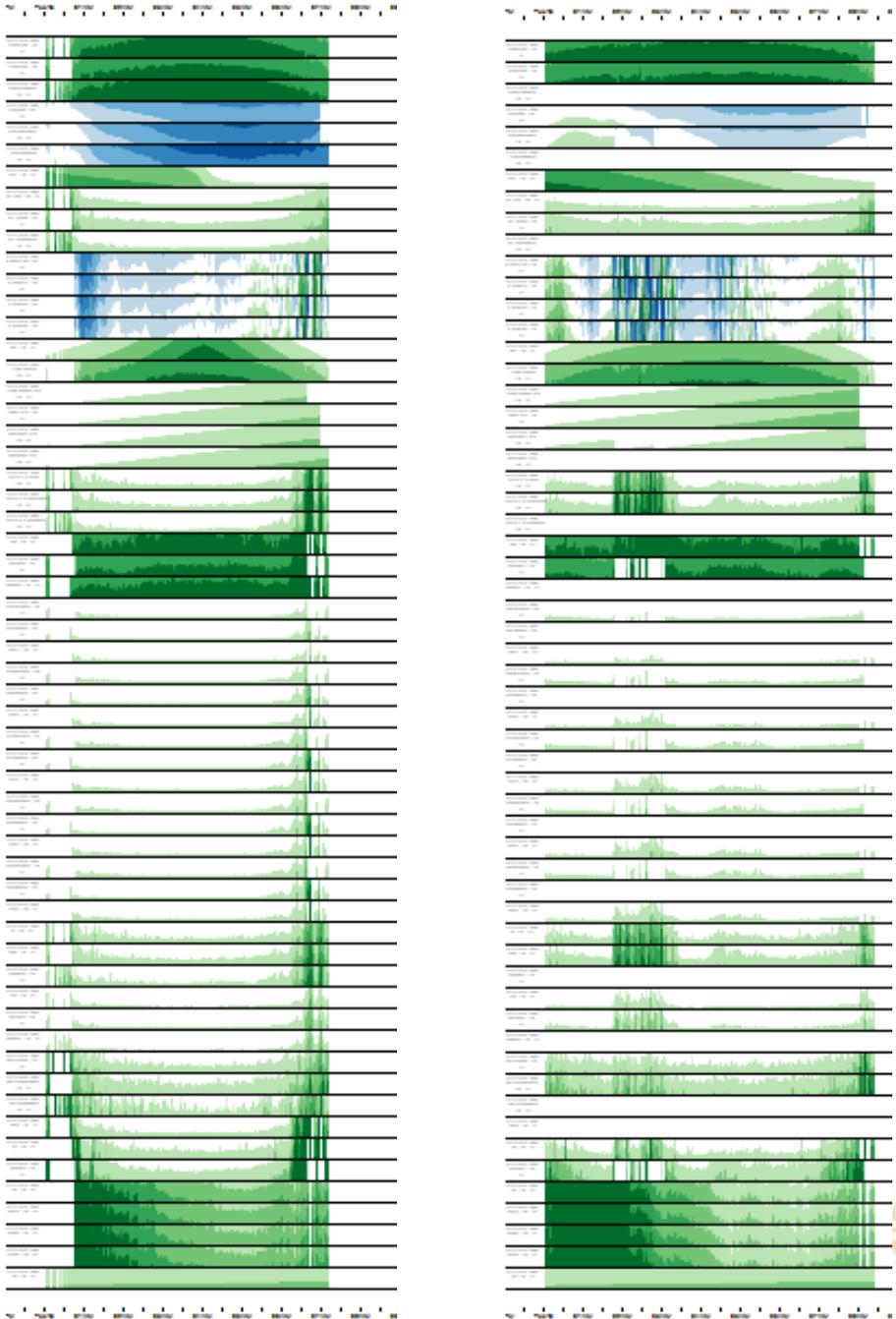
- Permitem a visualização sem sobreposição
- Interface de Edição de arquivos RINEX baseada na visualização de atributos



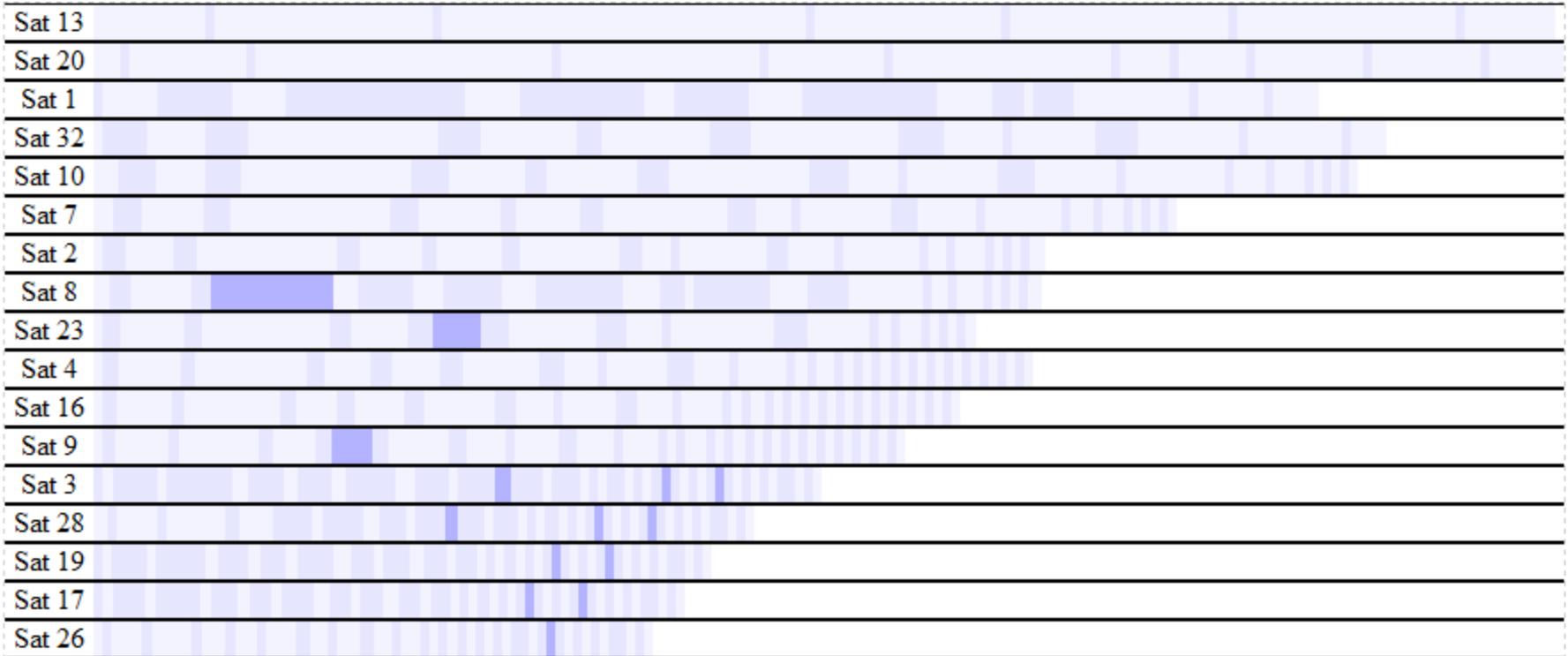
Visualização Cubism



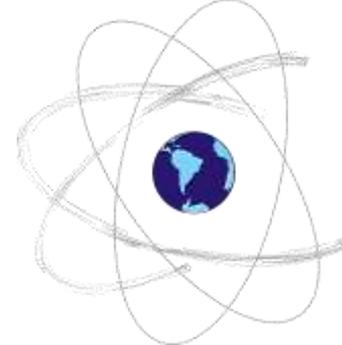
20/06/2013



Data Mining



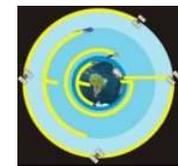
20/06/2013



Perspectivas Futuras e Considerações Finais



20/06/2013

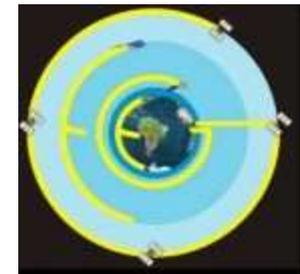


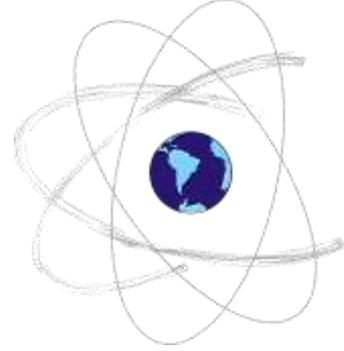
Perspectivas Futuras e Considerações Finais

- As estações de monitoramento da Ionosfera financiadas através do Projeto Temático GNSS-SP compõem uma rede juntamente com as estações constituídas através dos Projetos CIGALA e CALIBRA
 - Tais estações estão em funcionamento desde Fev/2011 e continuam a coletar dados
 - Destaca-se a colaboração dos parceiros que abrigam as estações
- Existe um banco de dados que mantém os registros de monitoramento de cada estação
- Está em constante desenvolvimento a ISMR Query Tool: software on-line para exploração e análise dos dados
 - Interface com os dados de monitoramento
 - Suporte a pesquisas em andamento e trabalhos futuros
- Existem trabalhos de Iniciação Científica, Mestrado e Doutorado sendo realizados neste contexto

Agradecimentos

- Parceiros





Perguntas? Comentários?

