

PROGRAM FOR

ESTUDO E
MONITORAMENTO
BRASILEIRO DO
CLIMA
ESPACIAL



EMBRACE

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Magnetometers Developed at Jicamarca to Implement the EMBRACE Magnet Network: Some Scientific Results and the South American Magnetic Index **Ksa**

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Review on space weather in Latin America. 2. The research networks ready for space weather

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San Jose de la Huerta Morelia, M

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AGUPUBLICATIONS

Radio Science

RESEARCH ARTICLE

10.1002/2017RS006477

Key Points:

- Magnetic measurements in South America ready for space weather
- Magnetic station measurement with near-observatory data quality
- New real-time data providing proxy for Dst and the new Ksa magnetic indices

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The Embrace Magnetometer Network for South America: Network Description and Its Qualification

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AGUPUBLICATIONS

Radio Science

RESEARCH ARTICLE

10.1002/2018RS006540

Key Points:

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The Embrace Magnetometer Network for South America: First Scientific Results

C. M. Denardini¹, S. S. Chen¹, L. C. A. Resende¹, J. Moro^{2,3}, A. V. Bilibio¹, P. R. Fagundes⁴, M. A. Gende^{5,6}, M. A. Cabrera^{7,8}, M. J. A. Bolzan⁹, A. L. Padilha¹, N. J. Schuch², J. L. Hormaechea^{5,10}, L. R. Alves¹, P. F. Barbosa Neto^{5,11}, P. A. B. Nogueira¹², G. A. S. Picanço¹, and T. O. Bertolotto^{5,13}

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Abstract The present work is the second of a two-part paper on the Embrace Magnetometer Network.

Denardini et al. (Radio Sci., 2018a,b)

Objectives:

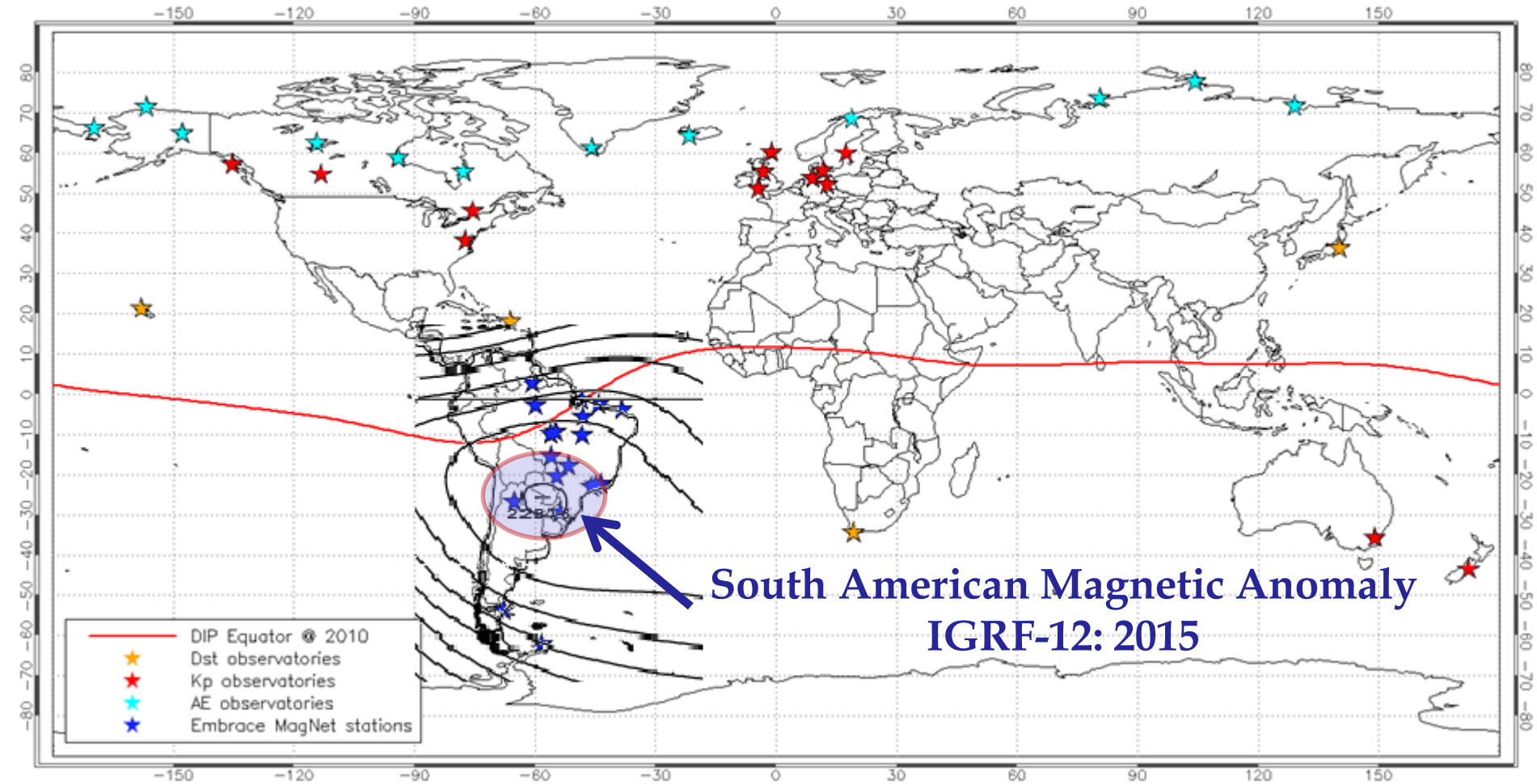
To monitor the Earth's magnetic fields variations along the eastern portion of the American sector to provide a toll to:

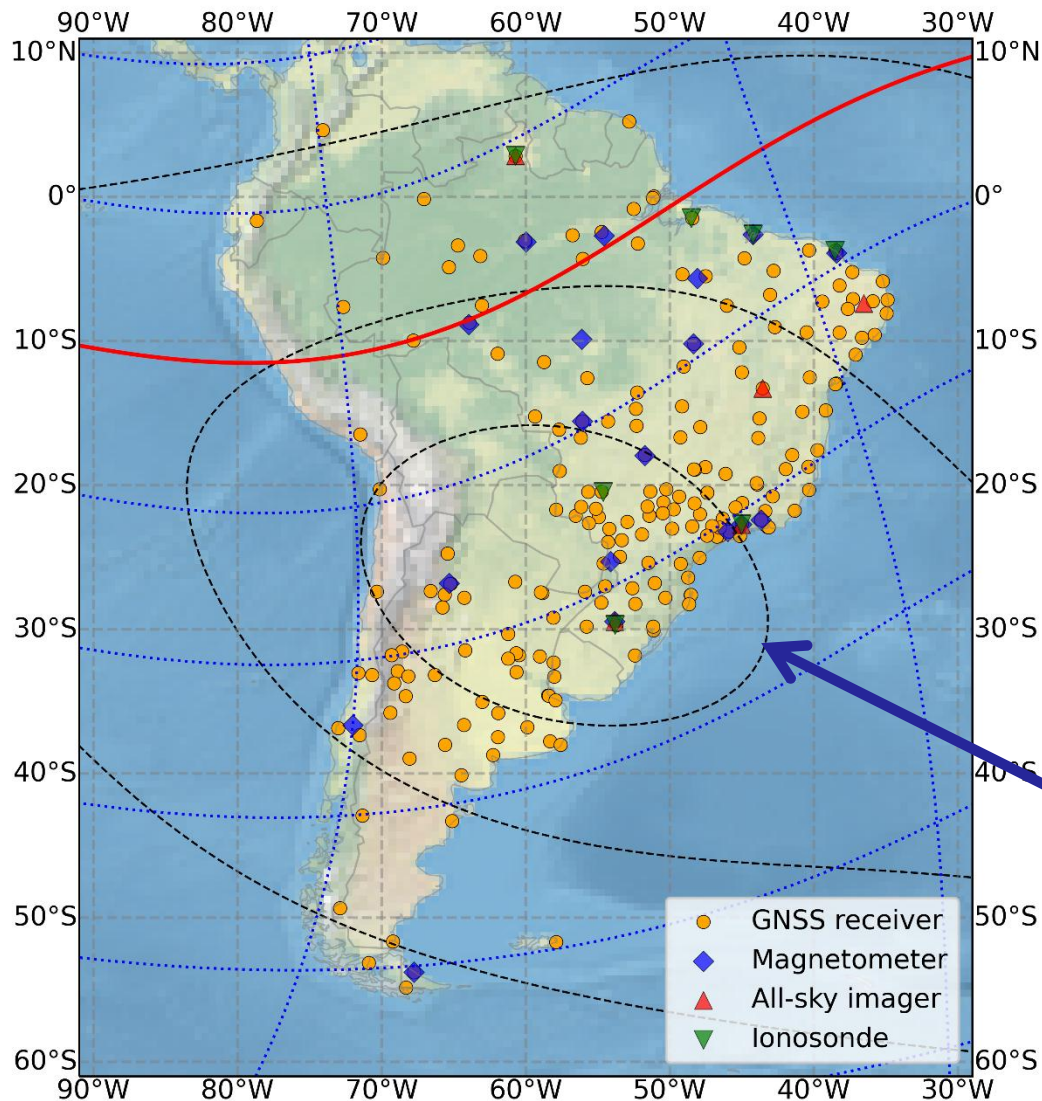
- a. **estimate** the electric fields at E and/or F regions heights;
- b. **provide** the ground induced effect of the EEJ (or CEJ);
- c. **provide** the time derivative of the field (dB/dt); and
- d. **monitor** the disturbance level based on the stations K-index

To achieve all the above variable it is crucial to have all the **EMBRACE Magnetometer Network** measuring with the same accuracy the variations of components since is need to have difference between measurements from different stations

South American Mag Anomaly

Courtesy:
Eng. Sony Su Chen





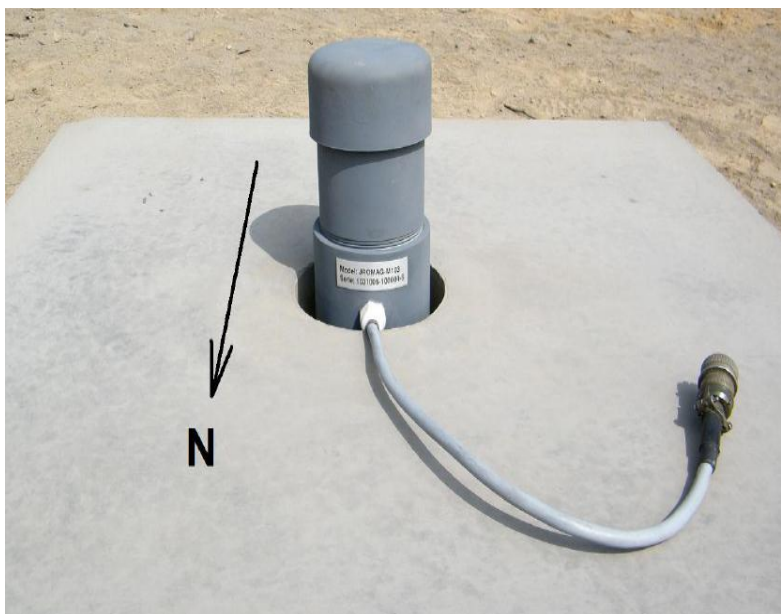
South American
Magnetic Anomaly

IGRF-12: 2015
30.000 nT

The Equipment



Measurement range	+/- 75000 nT
Dynamic range	+/- 250. 1000. 2500 nT
Resolution	0.1 nT
Accuracy	0.25%
Orthogonality	<0.5°
Offset at T=25 °C	<1 nT
Zero drift	<0.1 nT/C
Scaling temp. coeff.	+20 ppm/C. typ.
Supply voltages	+12 V
Current consumption	+220 mA





Picture of (a) the single bar sensor core that is built inside (b) the sealed magnetometer sensors tube, which composes the Embrace MagNet magnetometer system

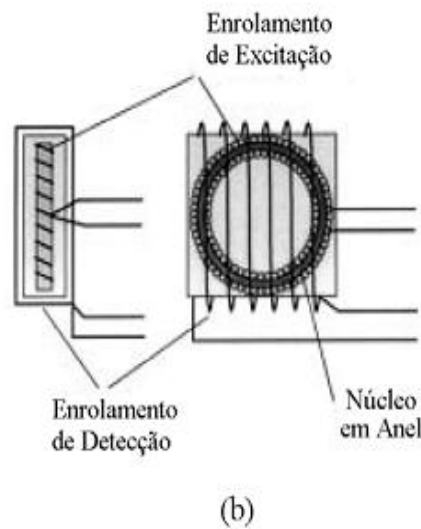
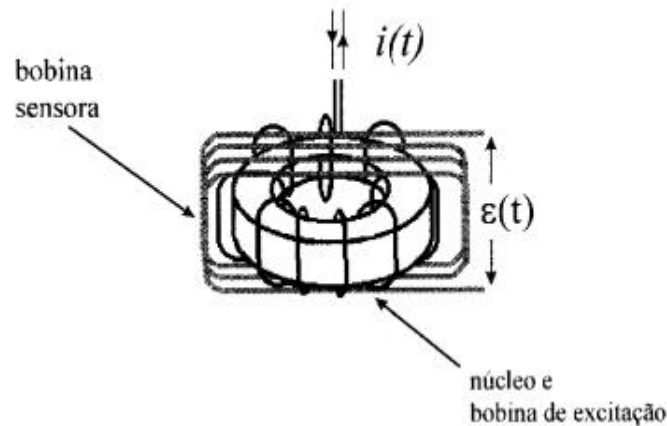
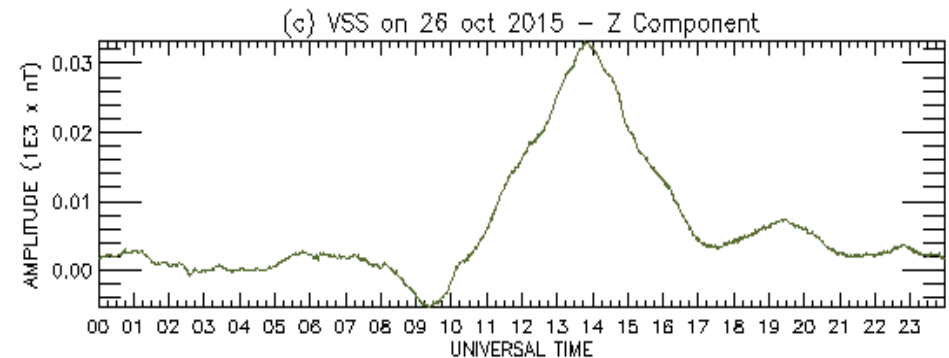
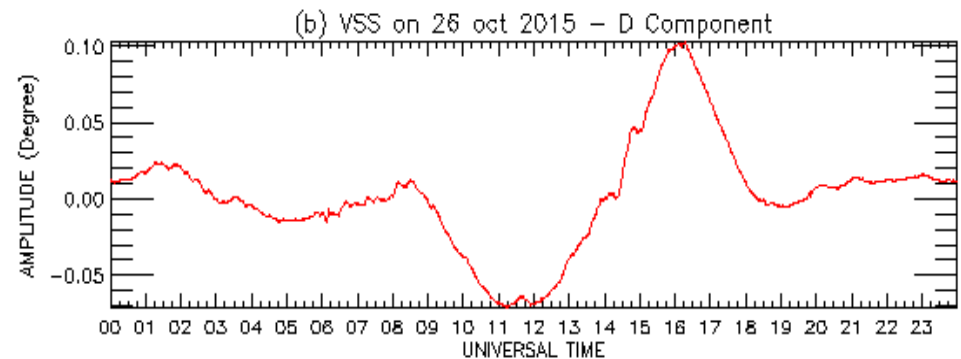
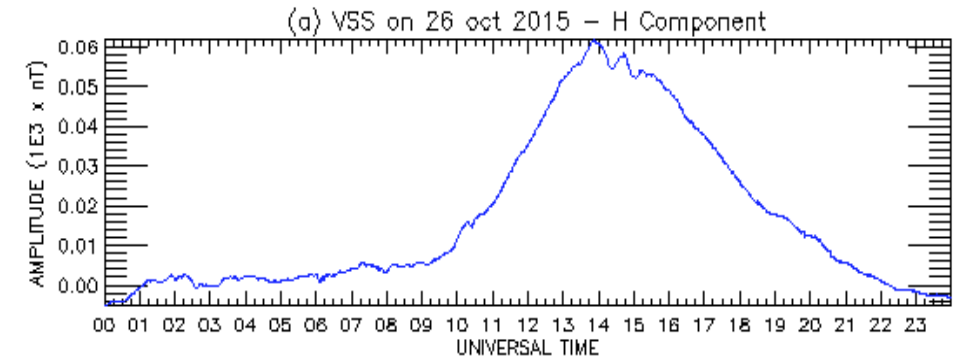


Figura 1 a) e b) – Esquema do magnetômetro de fluxgate.
After: CRASTO, 2003.



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Localização dos Magnetômetros

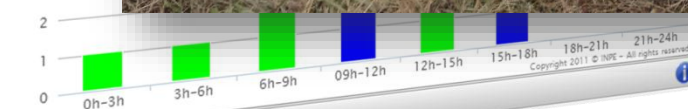
Magnetômetro: CACHOEIRA PAULISTA
 Data: 16/10/2012
 Buscar
 Taga Code: CXP Longitude: -45.014446 Latitude: -22.701944

Rede EMBRACE de Magnetômetros

(Rio Grande, Tierra del Fuego, Argentina - 15/11/2012)

Vertical (Z)
 Horizontal (H)
 75 nT
 50 nT
 25 nT
 0 nT
 -25 nT
 -50 nT
 -75 nT

Índice K



CACHOEIRA PAULISTA,
 CXP
 EUSÉBIO, EUS
 SÃO LUÍS, SLZ

Geomag. Lat. (°)	Observatory	Code	UN*	Geographic		Altitude (m)	DIP (°)	K9 Lower Limit
				Latitude	Longitude			
+09.4	Boa Vista - RR	BOA	BR	02°48'02"N	60°40'33"W	076	+18.80	400
+04.4	Manaus - AM	MAN	BR	02°53'18"S	59°58'11"W	102	+08.09	500
	Porto Velho - RO	PVE	BR	08°45'49"S	63°54'23"W	083		
-00.4	Belém - PA	BLM	BR	01°26'28"S	48°26'40"W	016	-00.80	600
-03.6	São Luís - MA	SLZ	BR	02°35'39"S	44°12'35"W	032	-07.26	500
-03.7	Alta Floresta - MT	ALF	BR	09°52'13"S	56°06'15"W	284	-07.50	500
-05.6	Araguatins - TO	ARA	BR	05°36'01"S	48°06'02"W	103	-11.30	450
-08.2	Eusébio - CE	EUS	BR	03°52'48"S	38°25'28"W	043	-16.51	400
-08.3	Palmas - TO	PAL	BR	10°17'50"S	48°21'41"W	231	-16.52	400
-08.5	Cuiabá - MT	CBA	BR	15°33'17"S	56°04'10"W	233	-17.10	400
	São João do Cariri - PB	CRR	BR	07°23'21"S	36°32'21"W	458		
-12.3	Jataí - GO	JAT	BR	17°55'55"S	51°43'05"W	679	-24.60	350
-13.7	Campo Grande - MS	CGR	BR	20°30'24"S	54°37'04"W	540	-25.50	350
-15.8	Tucumán - TU	TCM	AR	26°49'20"S	65°11'40"W	431	-27.35	300
	Medianeira - PR	MED	BR	25°17'43"S	54°05'38"W	402		
-18.9	Cachoeira Paulista - SP	CXP	BR	22°42'07"S	45°00'52"W	601	-36.43	300
-19.1	São José dos Campos - SP	SJC	BR	23°12'31"S	45°57'49"W	583	-36.64	300
-19.7	Vassouras - RJ	VSS	BR	22°24'07"S	43°39'08"W	443	-38.40	300
-21.6	São Martinho da Serra - RS	SMS	BR	29°26'37"S	53°49'22"W	462	-36.65	300
	Chillán - CO	CHI	CH	36°38'15"S	71°59'57"W	124		
	Aiguá - MA	AIG	UY	34°12'16"S	54°45'38"W	112		
	Bahia Blanca - BA	BBA	AR	38°41'00"S	62°15'37"W	020		
-39.9	Rio Grande - TF	RGA	AR	53°47'09"S	67°45'42"W	010	-50.03	400
-58.4	Estação Cmte. Ferraz-AC	ECF	BR	62°05'06"S	58°24'12"W	010	-53.20	800

* UN = Country, AR = Argentine, BR = Brazil, CH = Chile, UY = Uruguay

Denardini et al. (2016), Advances in Space Research

"Review on space weather in Latin America. 2. The research networks ready for space weather"

TCM



EMBRACE-01 TCM



EUS



EMBRACE-02 EUS



SLZ



EMBRACE-03 SLZ



RGA



EMBRACE-04 RGA



CXP



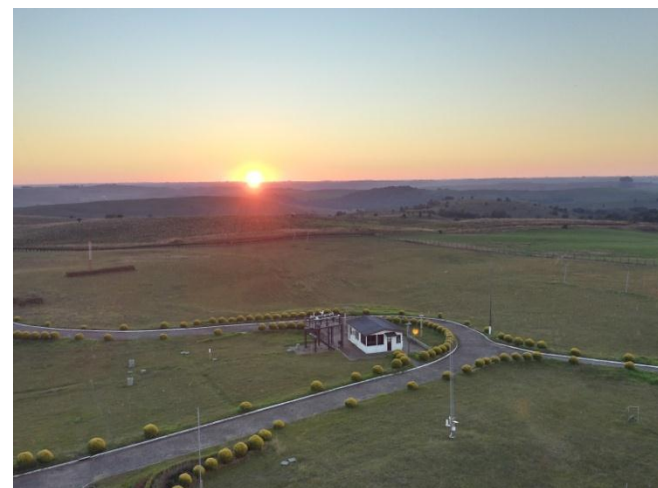
EMBRACE-05 CXP



SMS



EMBRACE-06 SMS



VSS



EMBRACE-07 VSS



CBA



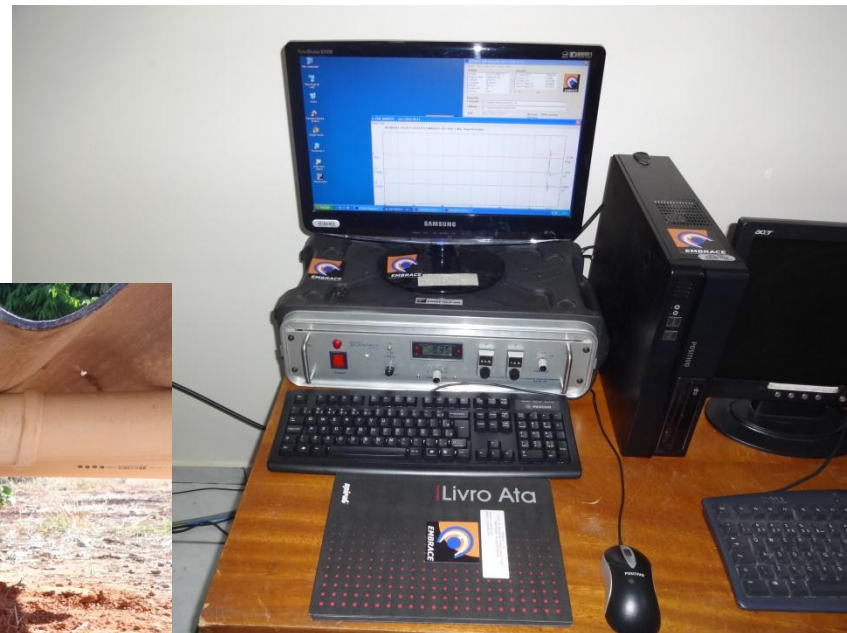
EMBRACE-08 CBA



AFT



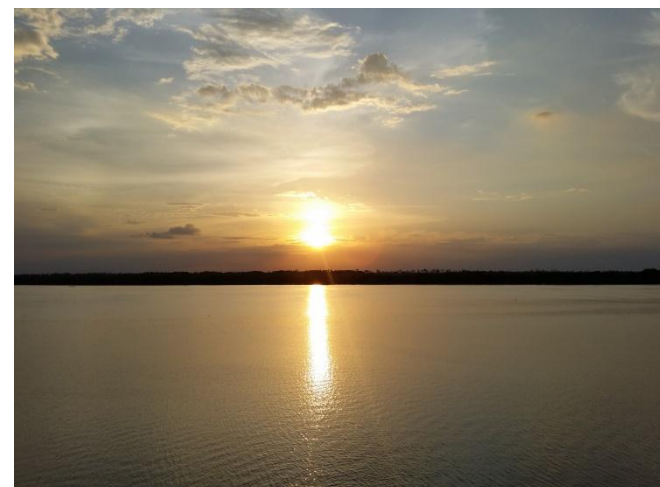
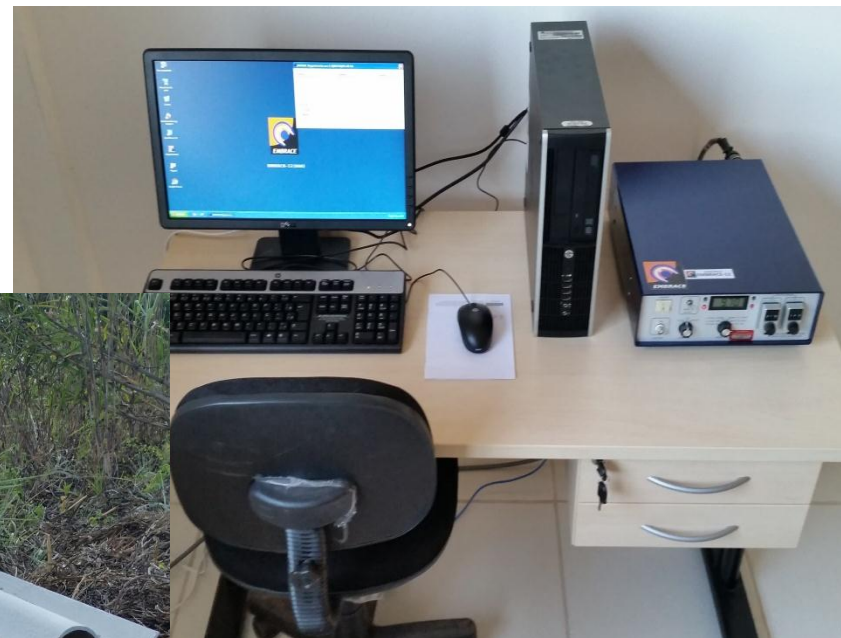
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ARA



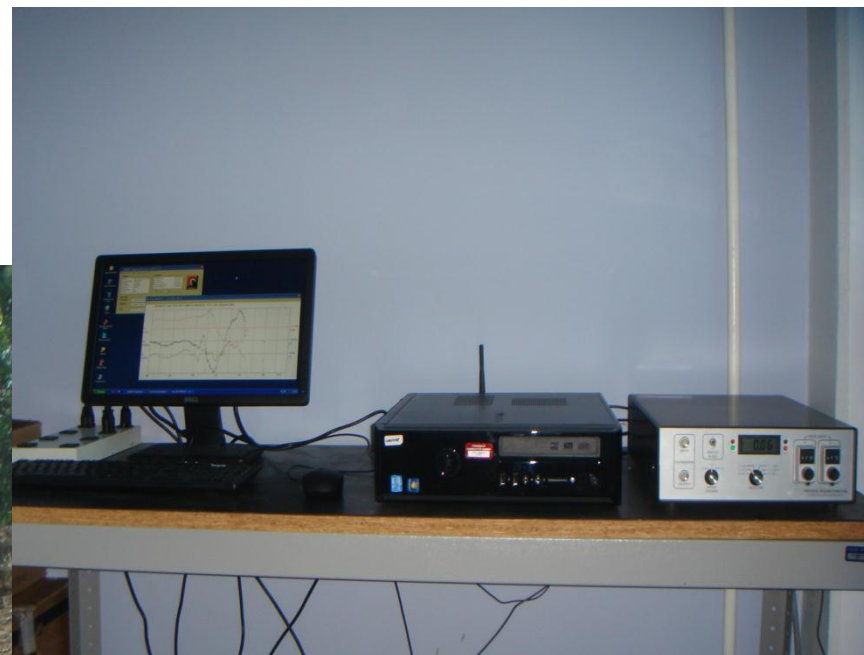
EMBRACE-12 ARA



SJC



UNIVAP-01 SJC



JAT



UNIVAP-02 JAT



21 11 2013



21 11 2013

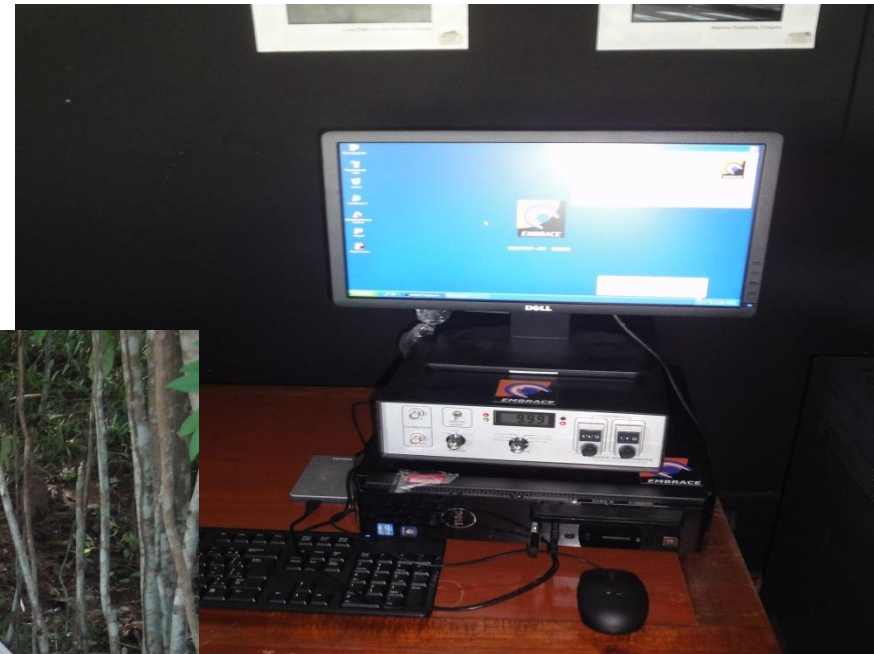


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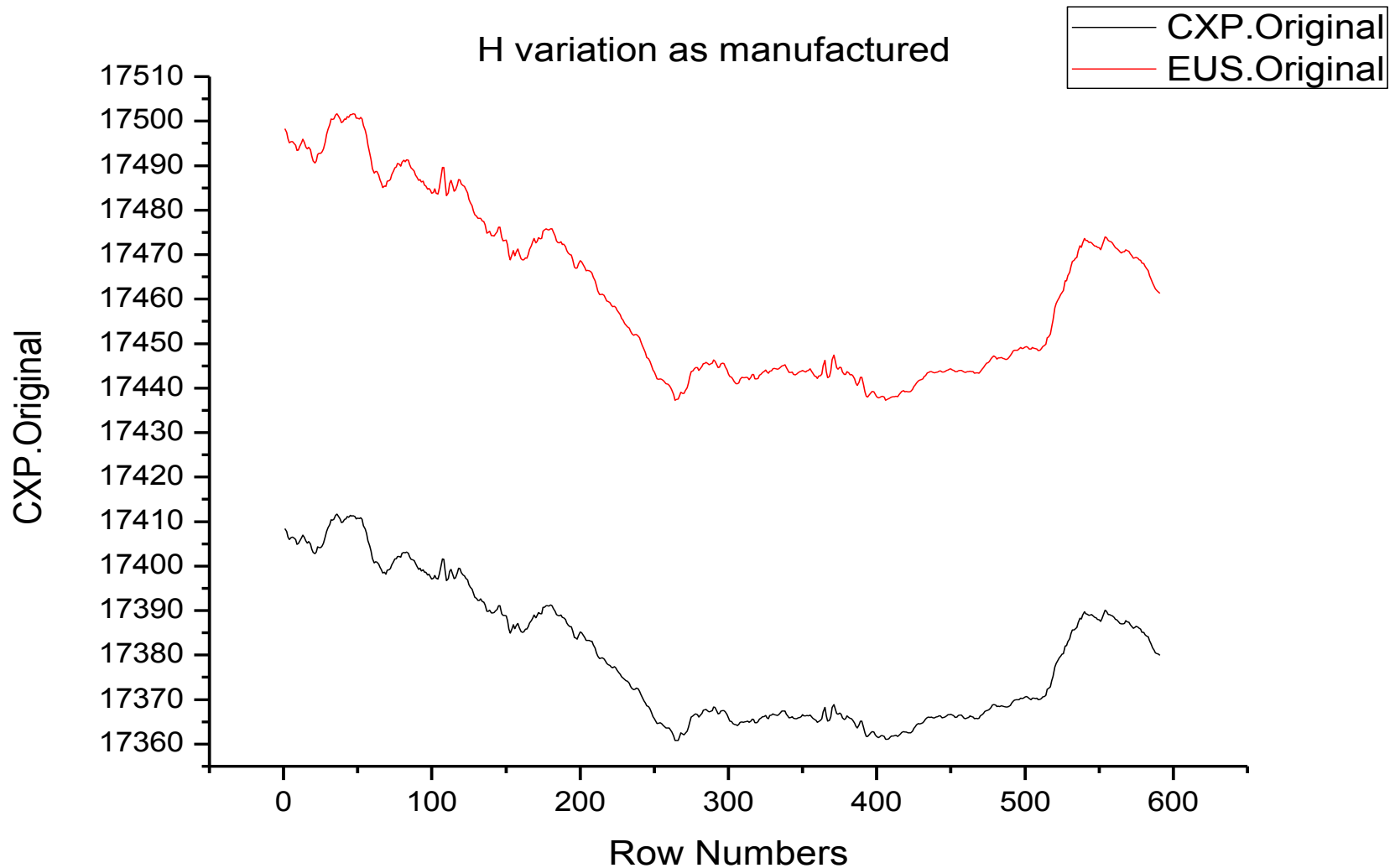
MAN



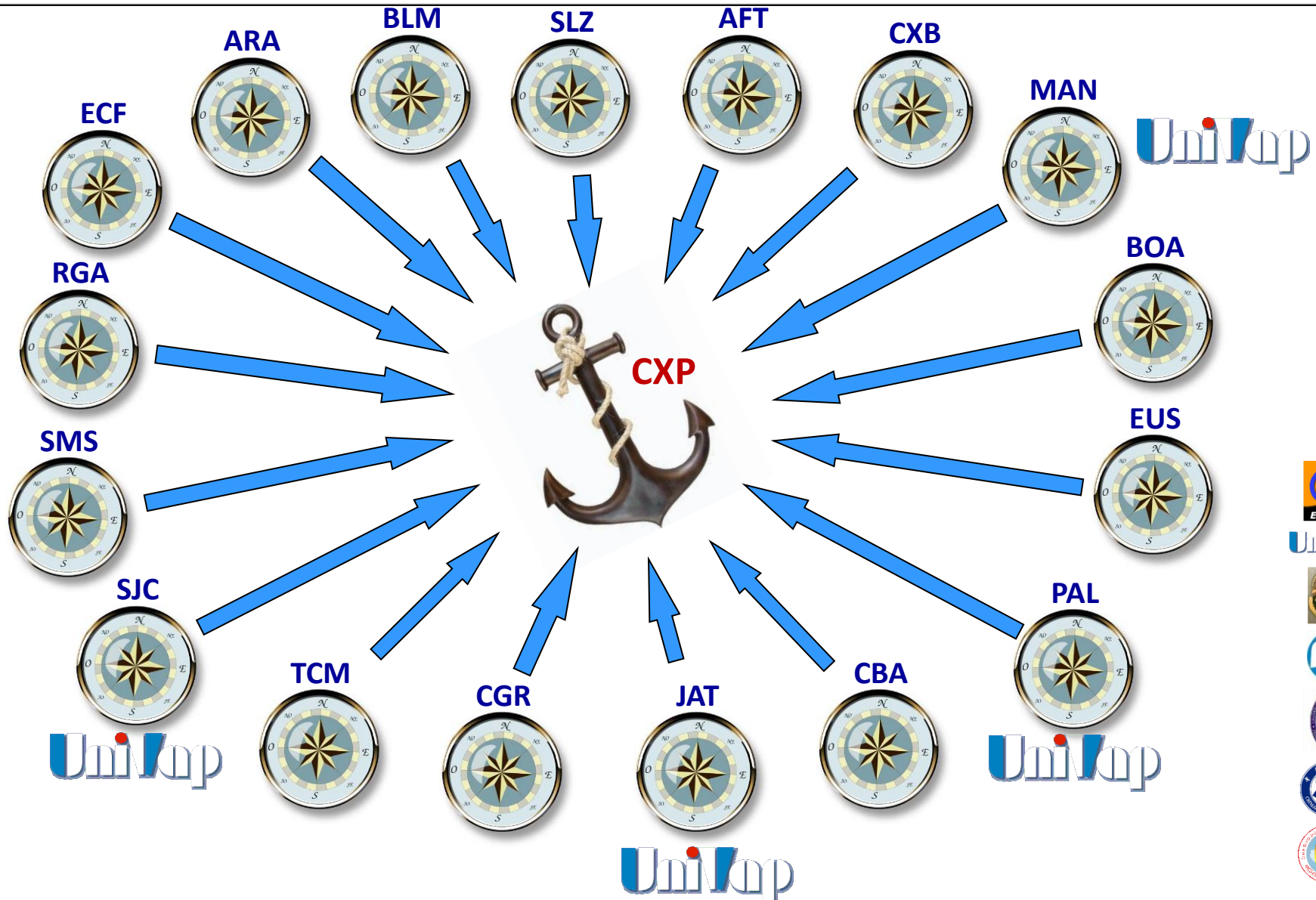
UNIVAP-03 MAN



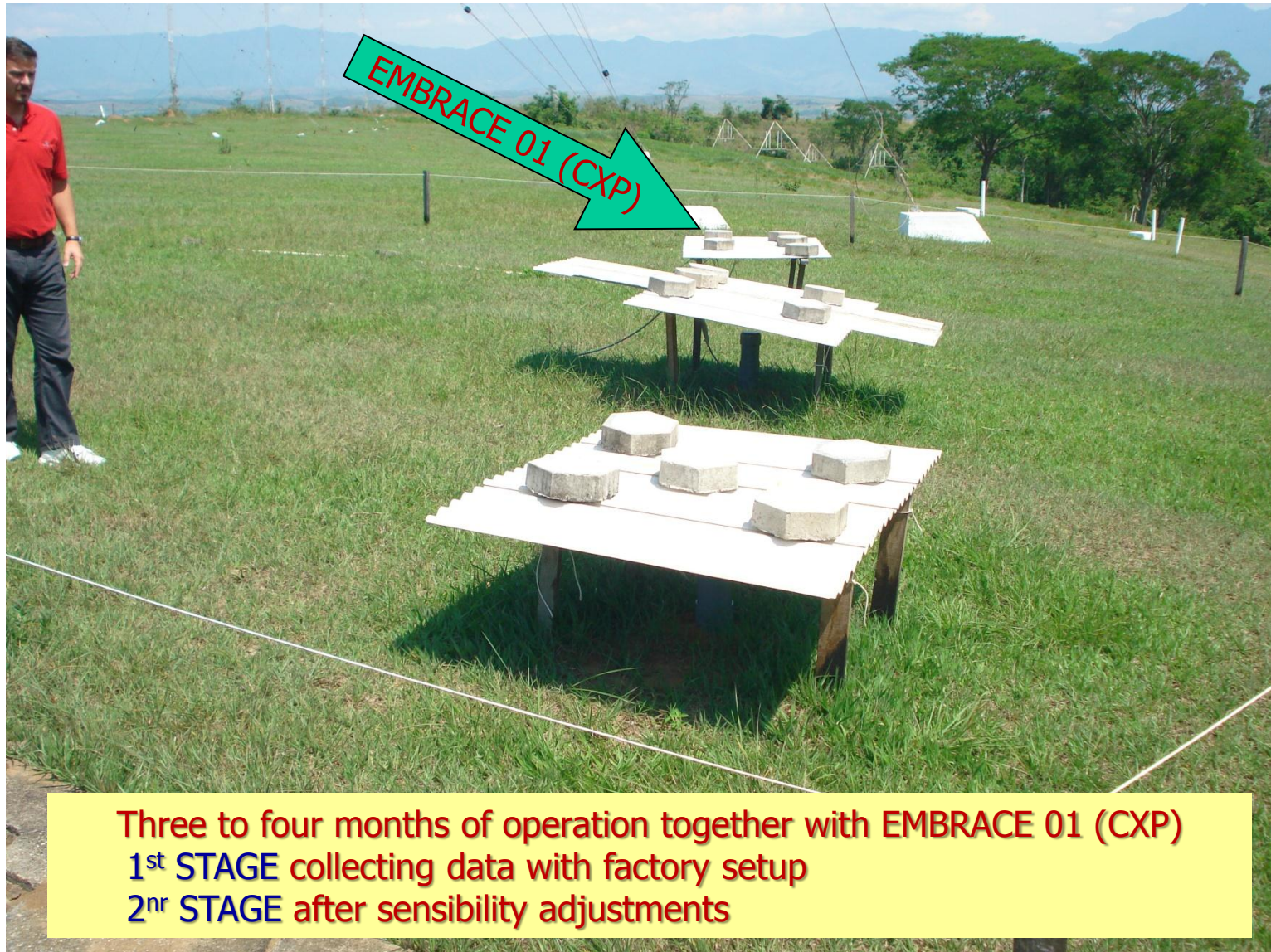
How we bought it ?



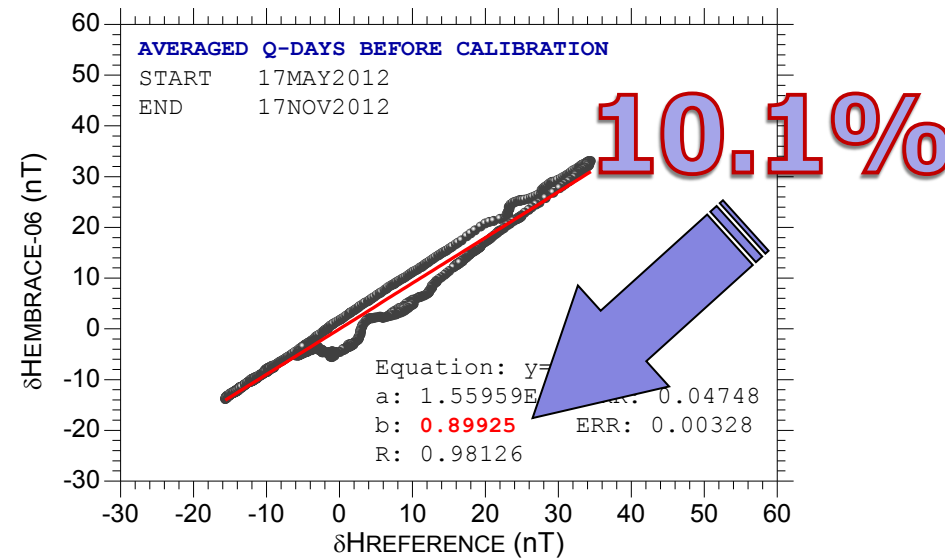
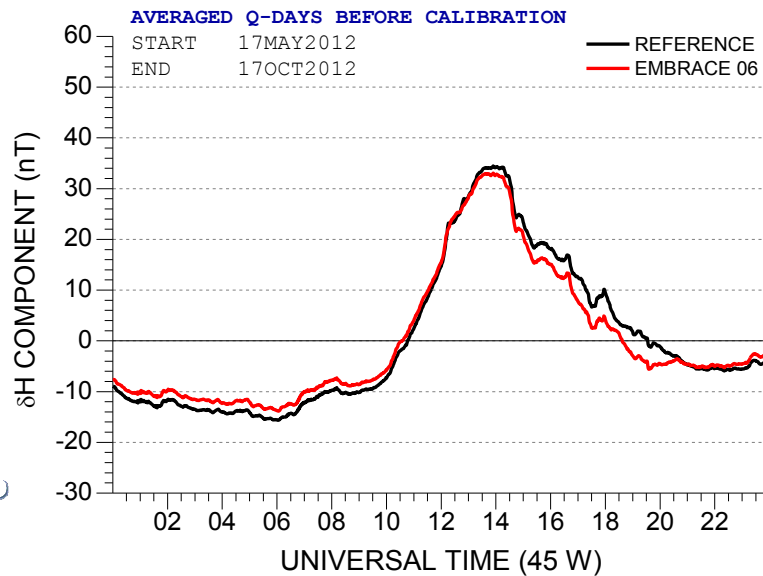
How we calibrate them ?



Installing all of them together



4 months collecting data together



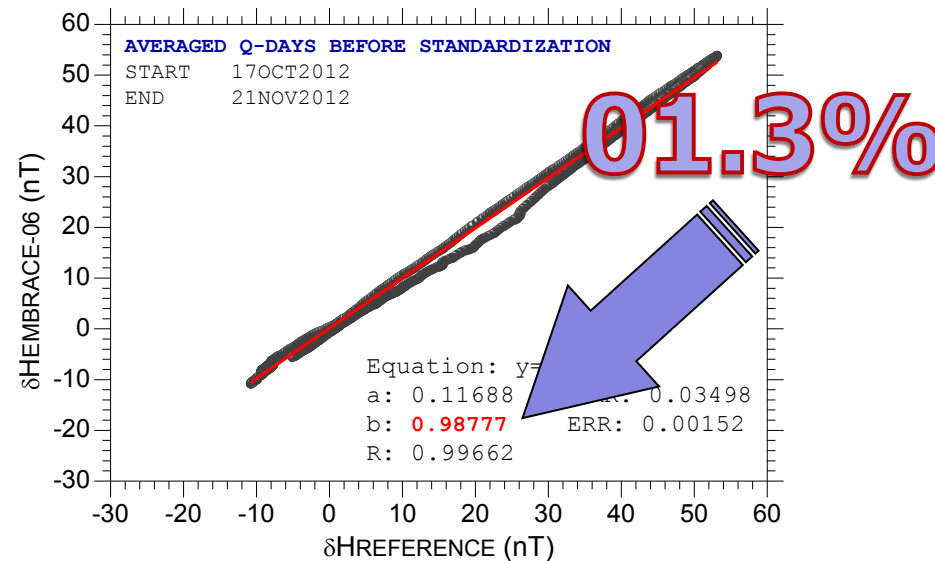
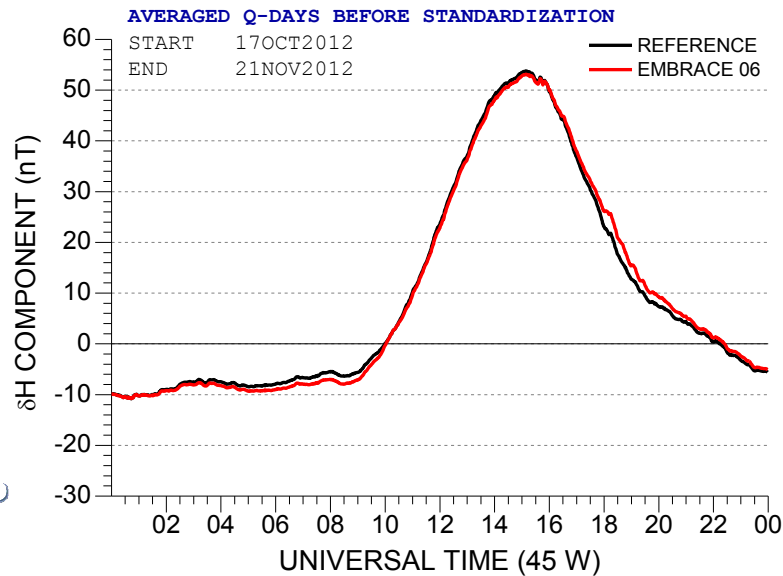
5 Quietest Days in the Month (WDC @ Kyoto)

YYYY MM q1q2q3q4q5 q6q7q8q9q0 d1d2d3d4d5
 2012 01 1419 43118 20 8 1 215 2224252316

SETUP

STEP 02 - Standardization

after calibrate another month collecting data together

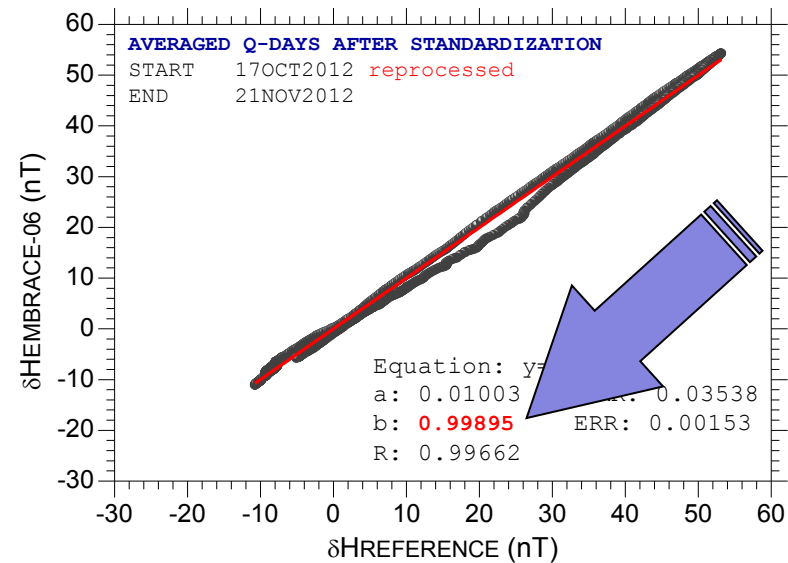
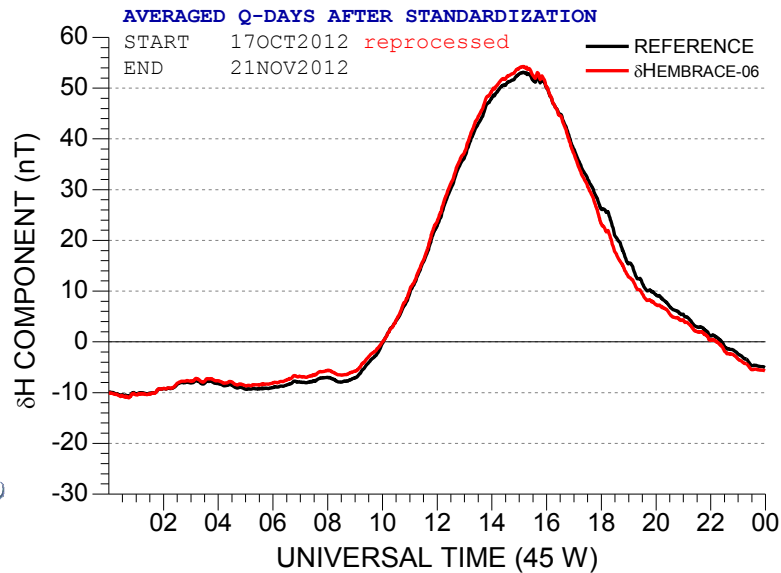


5 Quietest Days in the Month (WDC @ Kyoto)

YYYY MM q1q2q3q4q5 q6q7q8q9q0 d1d2d3d4d5
2012 01 1419 43118 20 8 1 215 2224252316

SETUP

after standardize the collected data is reprocessed with final sensibility adjustments



Network Error Goal $< 1 \%$
 $< 0.2 \%$ in this example

Magnetometer Labels		Maximum error with respect to the reference			
Reference	Under Evaluation	H	D	Z	F
EMBRACE-01	EMBRACE-02	+0.237 %	-0.053 %	+0.112 %	±0.247 %
EMBRACE-01	EMBRACE-03	-0.116 %	+0.001 %	+0.084 %	±0.141 %
EMBRACE-01	EMBRACE-04	-0.252 %	-0.199 %	+0.648 %	±0.637 %
EMBRACE-01	EMBRACE-05	+0.064 %	-0.053 %	+0.088 %	±0.107 %
EMBRACE-05	EMBRACE-06	-0.105 %	-0.015 %	-0.073 %	±0.126 %
EMBRACE-05	EMBRACE-07	-0.028 %	-0.068 %	-0.083 %	±0.078 %
EMBRACE-05	EMBRACE-08	+0.178 %	-0.121 %	-0.103 %	±0.053 %
EMBRACE-05	EMBRACE-09	-0.099 %	+0.089 %	+0.041 %	±0.041 %
EMBRACE-05	UNIVAP-01	-0.863 %	+0.453 %	+0.133 %	±0.705 %
EMBRACE-05	UNIVAP-02	-0.121 %	-0.165 %	-0.141 %	±0.186 %
EMBRACE-05	UNIVAP-03	-0.075 %	-0.002 %	-0.102 %	±0.125 %
Averaged Square Error		±0.194 %	±0.111 %	±0.146 %	±0.222 %

Denardini et al. (2015), Brazilian Journal of Geophysics

"The initial steps for developing the South American k index from the embrace magnetometer network"

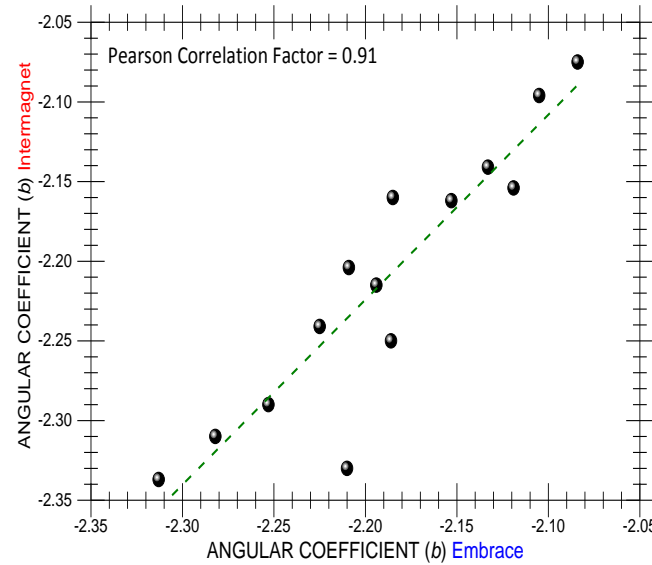
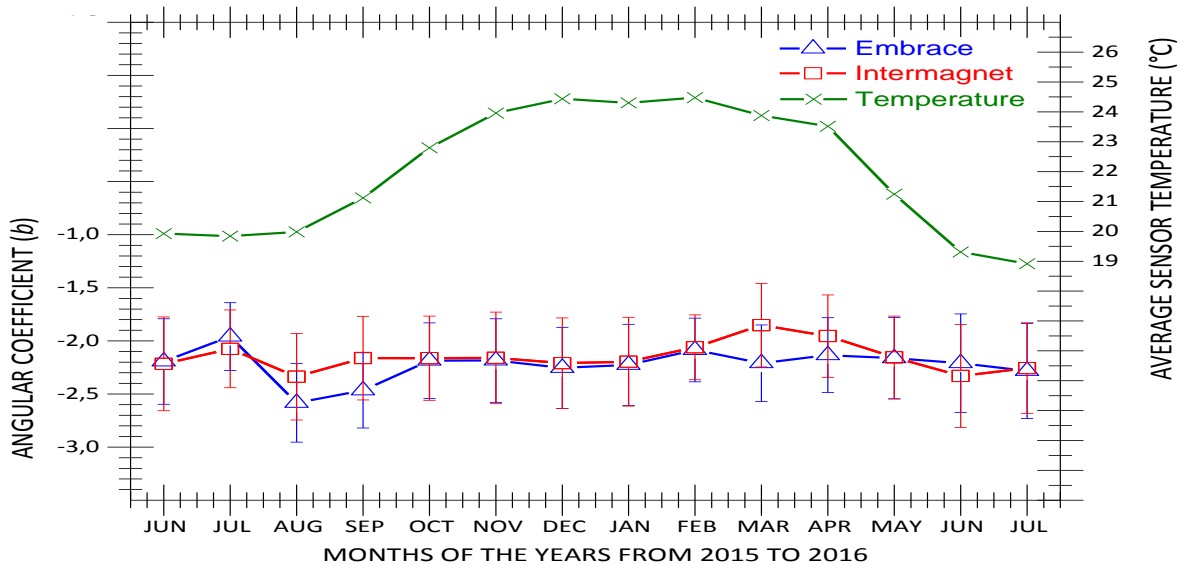
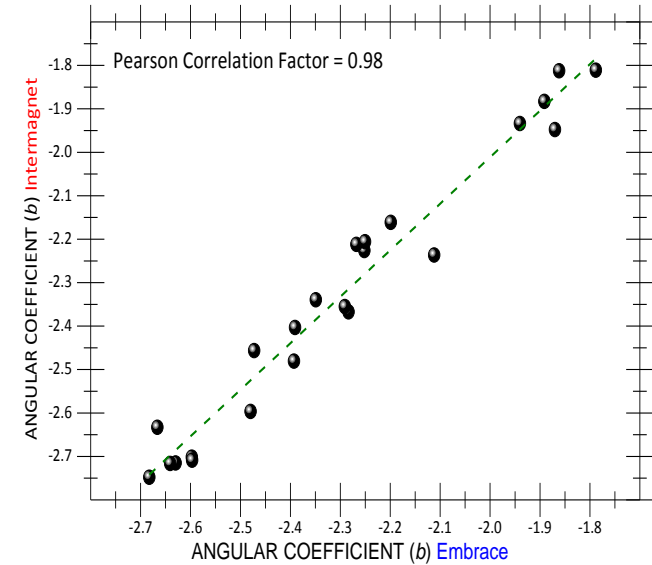
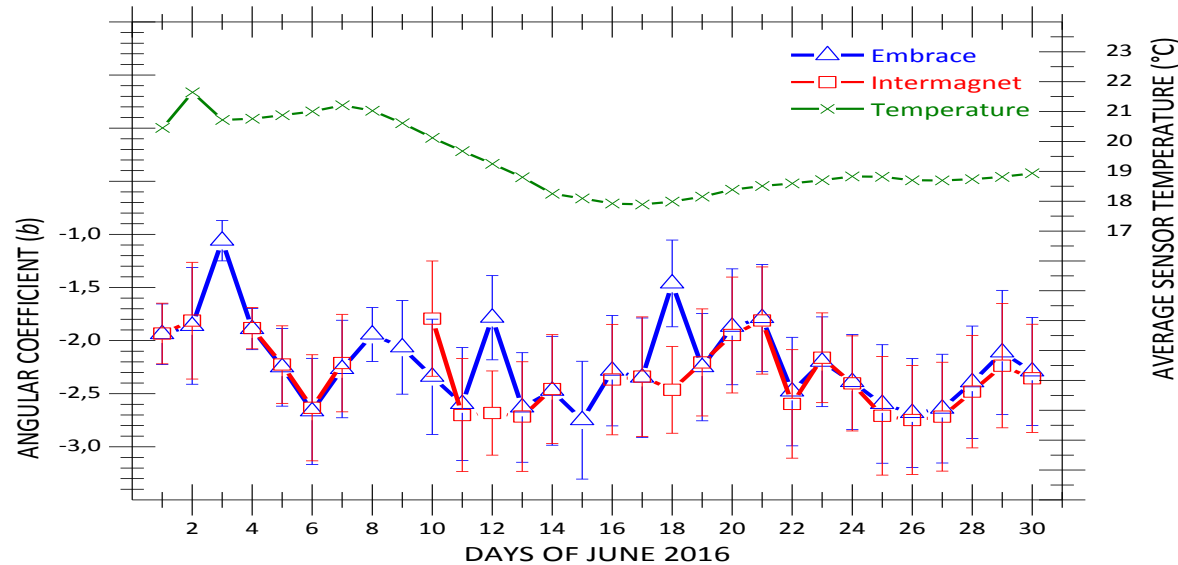
TECHNICAL DETAILS

	Embrace MagNet	Intermagnet
Measurement range	+/- 75000 nT	-
Dynamic range	+/- 250, 1000, 2500 nT	-
Resolution	0.1 nT	0.1 nT
Accuracy	0.25%	-
Orthogonality	<0.5°	-
Offset at T=25 °C	<1 nT	-
Thermal stability	<0.1 nT/°C	0.25 nT/°C
Scaling temp. coeff.	+20 ppm/C, typ.	-
Supply voltages	+12 V (10.5 ~ 28.0 V)	-
Current consumption	+220 mA	-
Sampling rate	1 Hz	1 Hz
Band pass	DC to 3 kHz	DC to 0.1 Hz
Long term stability	-	5 nT/year

PROCEDURE FOR THE VERIFICATION

- 1) Select the 5 most quietest days for each month (June, 2015 to May, 2016);
- 2) Select the magnetic data from Embrace MagNet and INTERMAGNET;
- 3) Remove the local midnight value for each day;
- 4) Correlate the magnetic data; and
- 5) Separate the correlation values by seasons.

Embrace vs Intermagnet



Embrace vs Intermagnet

~60 days
~360 magnetic files

Winter

2015/june

2015/july

2015/august

2016/may

Equinox

2015/september

2015/october

2016/march

2016/april

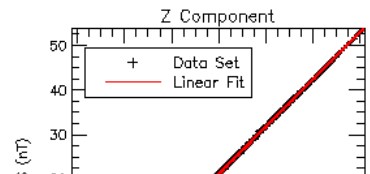
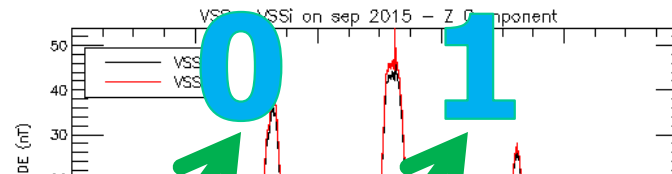
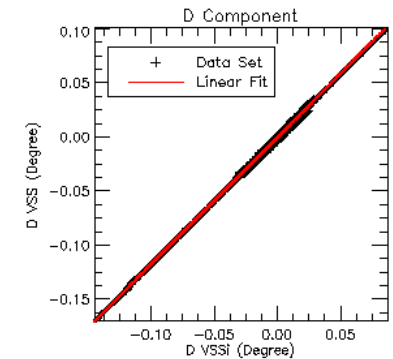
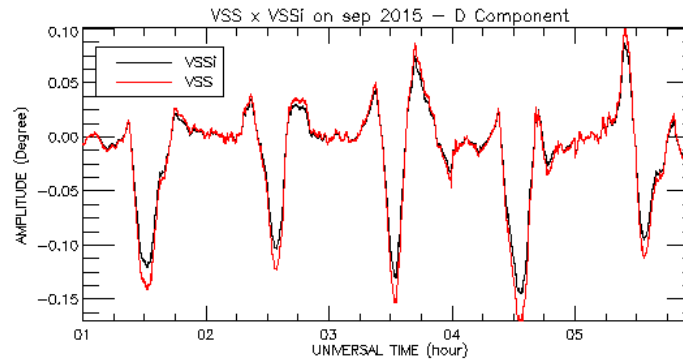
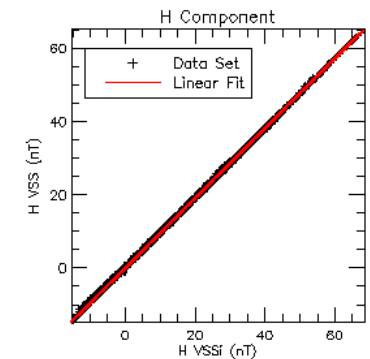
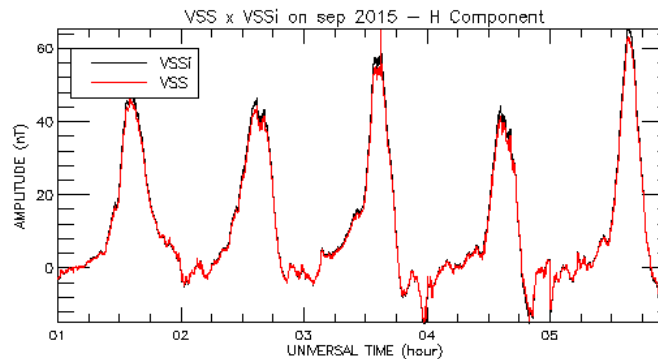
Summer

2015/november

2015/december

2016/january

2016/february



$$\Delta H_{VSSi}(t) \cong \cancel{A} + \cancel{B} \Delta H_{VSS}(t)$$

Embrace vs Intermagnet

H

D

Z

H	A	B	R-Square
2015/jun	0,16162	0,95815	0,99920
2015/jul	0,22038	0,95469	0,99898
2015/aug	0,24138	0,94639	0,99948
2016/may	-0,02490	0,96571	0,99969
Winter	0,14962	0,95624	0,99934

2015/sep	0,01404	0,95426	0,99971
2015/oct	0,06055	0,95587	0,99950
2016/mar	-0,05412	0,95984	0,99995
2016/apr	-0,22769	0,95769	0,99912
Equinox	-0,05181	0,95692	0,99957

2015/nov	-0,08442	0,95716	0,99982
2015/dec	-0,12195	0,95700	0,99956
2016/jan	-0,31674	0,95675	0,99846
2016/feb	-0,30272	0,96419	0,99953
Summer	-0,20646	0,95878	0,99934

Mean	-0,03621	0,95731	0,99942
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4,3 %

$$\Delta H_{VSSI}(t) \cong A_H + B_H \Delta H_{VSS}(t)$$

D	A	B	R-Square
2015/jun	-0,00082	1,16770	0,99634
2015/jul	-0,00047	1,16800	0,99754
2015/aug	-0,00018	1,17048	0,99922
2016/may	-0,00027	1,17159	0,99706
Winter	-0,00044	1,16944	0,99754

2015/sep	-0,00023	1,17663	0,99931
2015/oct	-0,00016	1,17766	0,99933
2016/mar	-0,00057	1,16074	0,99963
2016/apr	-0,00108	1,16792	0,99887
Equinox	-0,00051	1,17074	0,99929

2015/nov	0,00001	1,17048	0,99963
2015/dec	-0,00044	1,16507	0,99899
2016/jan	-0,00010	1,16752	0,99875
2016/feb	-0,00008	1,15985	0,99959
Summer	-0,00015	1,16573	0,99924

Mean	-0,00037	1,16864	0,99869
------	----------	---------	---------

16,9 %

$$\Delta D_{VSSI}(t) \cong A_D + B_D \Delta D_{VSS}(t)$$

Z	A	B	R-Square
2015/jun	-0,30760	1,05136	0,98875
2015/jul	0,13732	1,05447	0,99725
2015/aug	0,20891	1,05870	0,99459
2016/may	-0,06497	1,04964	0,99844
Winter	-0,00658	1,05354	0,99476

2015/sep	0,05886	1,05866	0,99936
2015/oct	0,02481	1,06206	0,99850
2016/mar	0,04412	1,06464	0,99912
2016/apr	-0,26643	1,05650	0,99578
Equinox	-0,03466	1,06047	0,99819

2015/nov	0,00758	1,05160	0,99876
2015/dec	0,09987	1,05482	0,99668
2016/jan	-0,30475	1,07379	0,98157
2016/feb	-0,27267	1,05786	0,99830
Summer	-0,11749	1,05952	0,99383

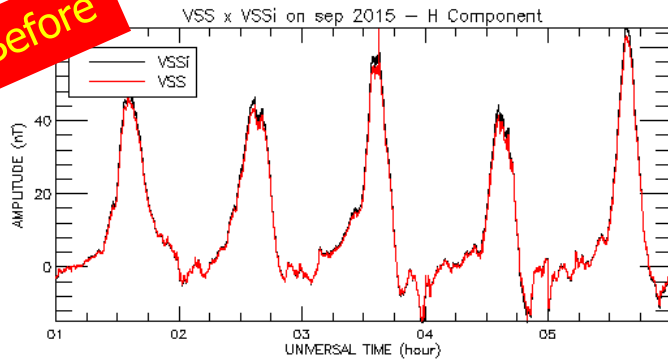
Mean	-0,05291	1,05784	0,99559
------	----------	---------	---------

5,8 %

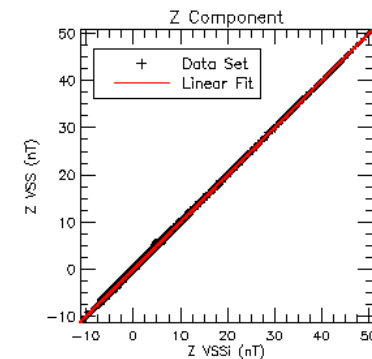
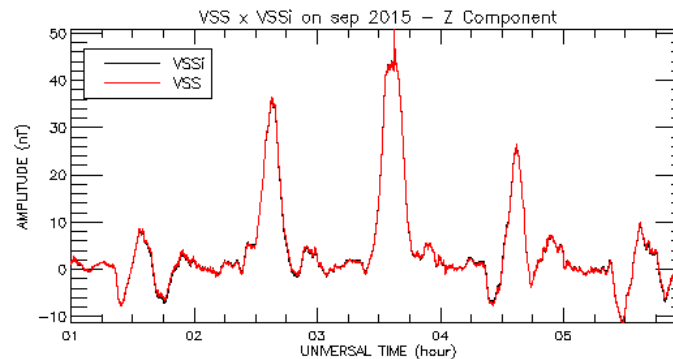
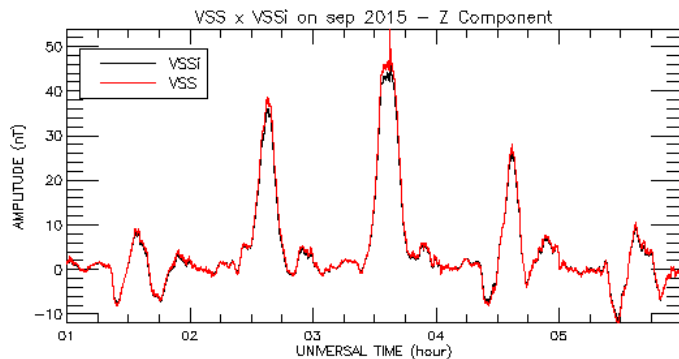
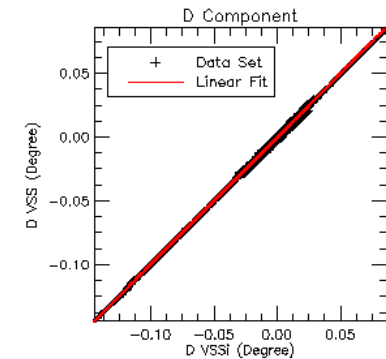
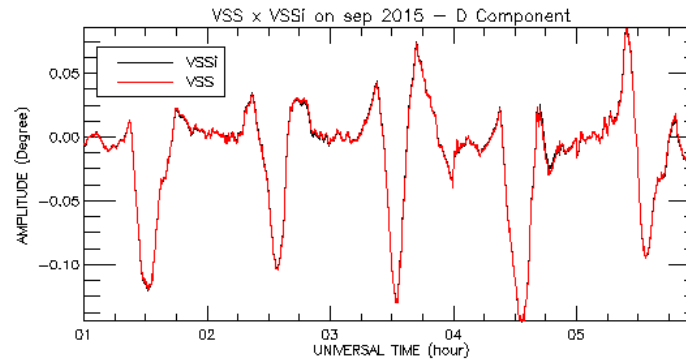
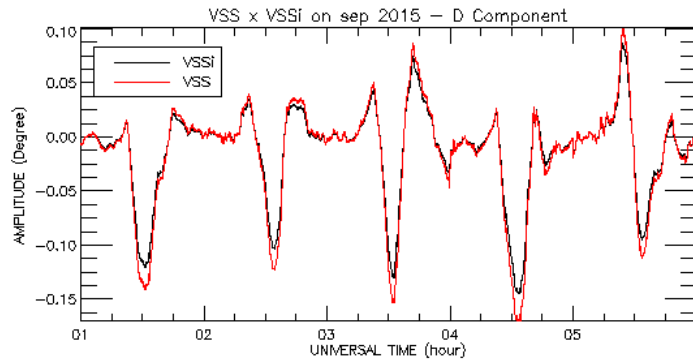
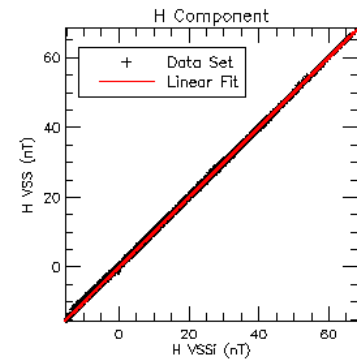
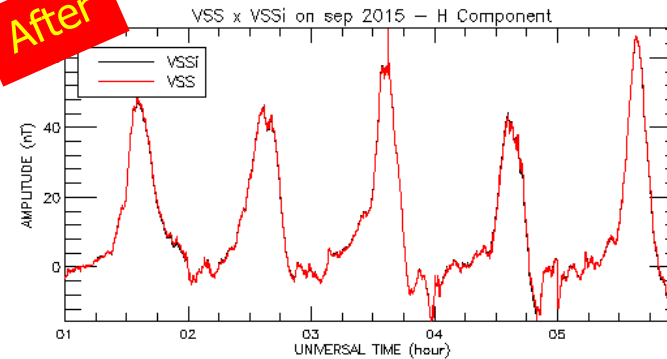
$$\Delta Z_{VSSI}(t) \cong A_Z + B_Z \Delta Z_{VSS}(t)$$

Embrace vs Intermagnet

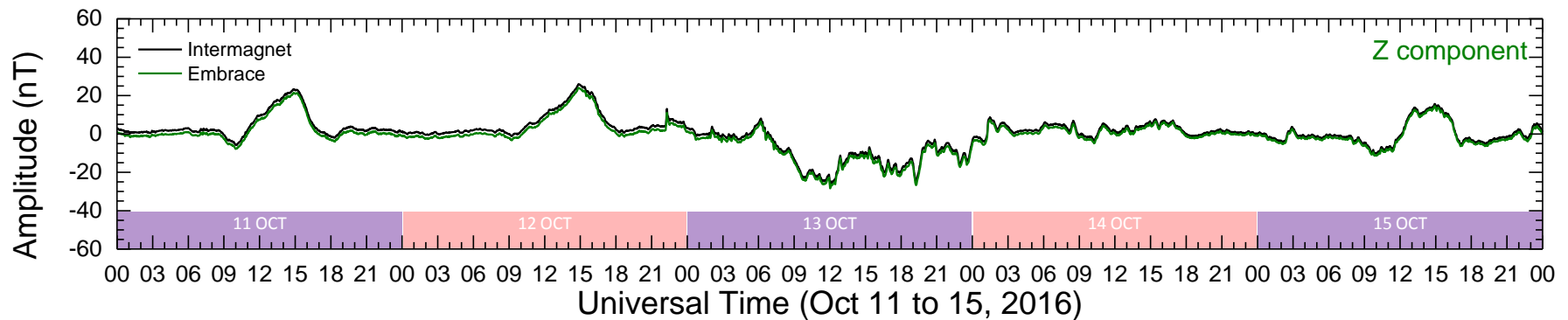
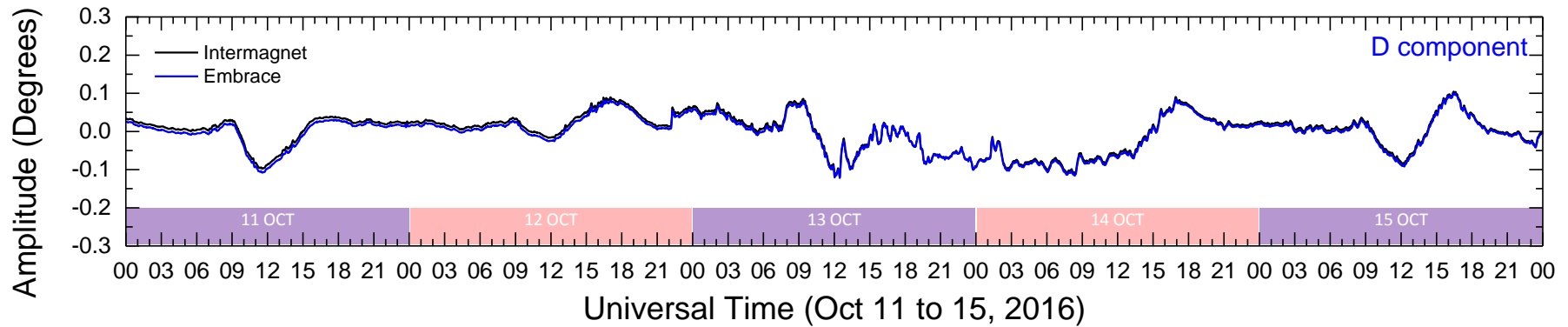
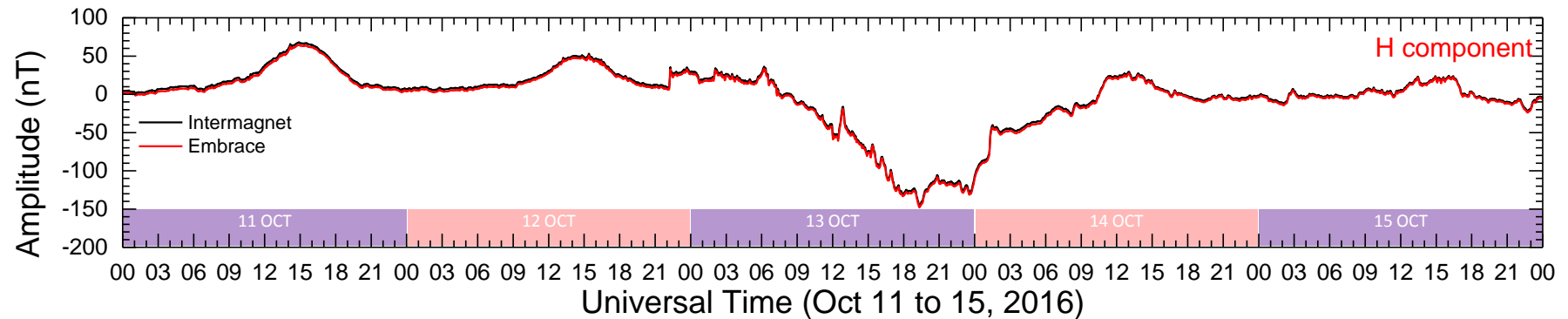
Before



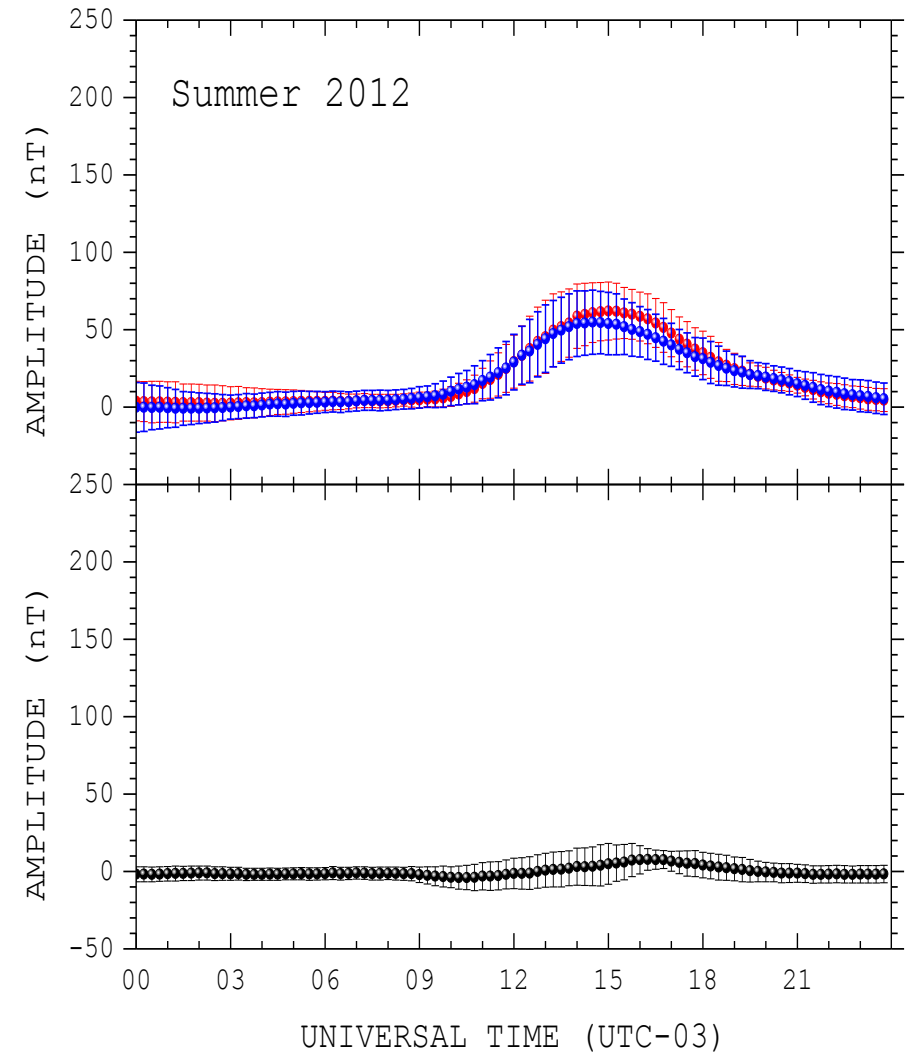
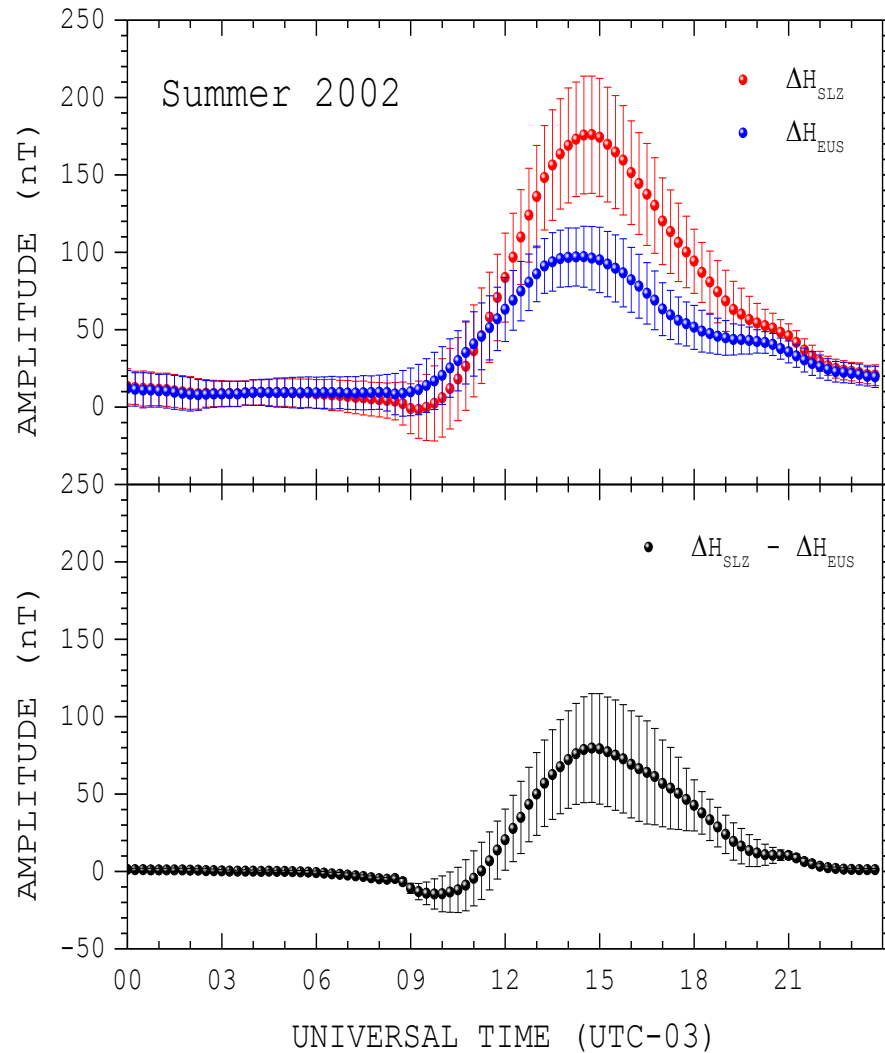
After



Embrace vs Intermagnet

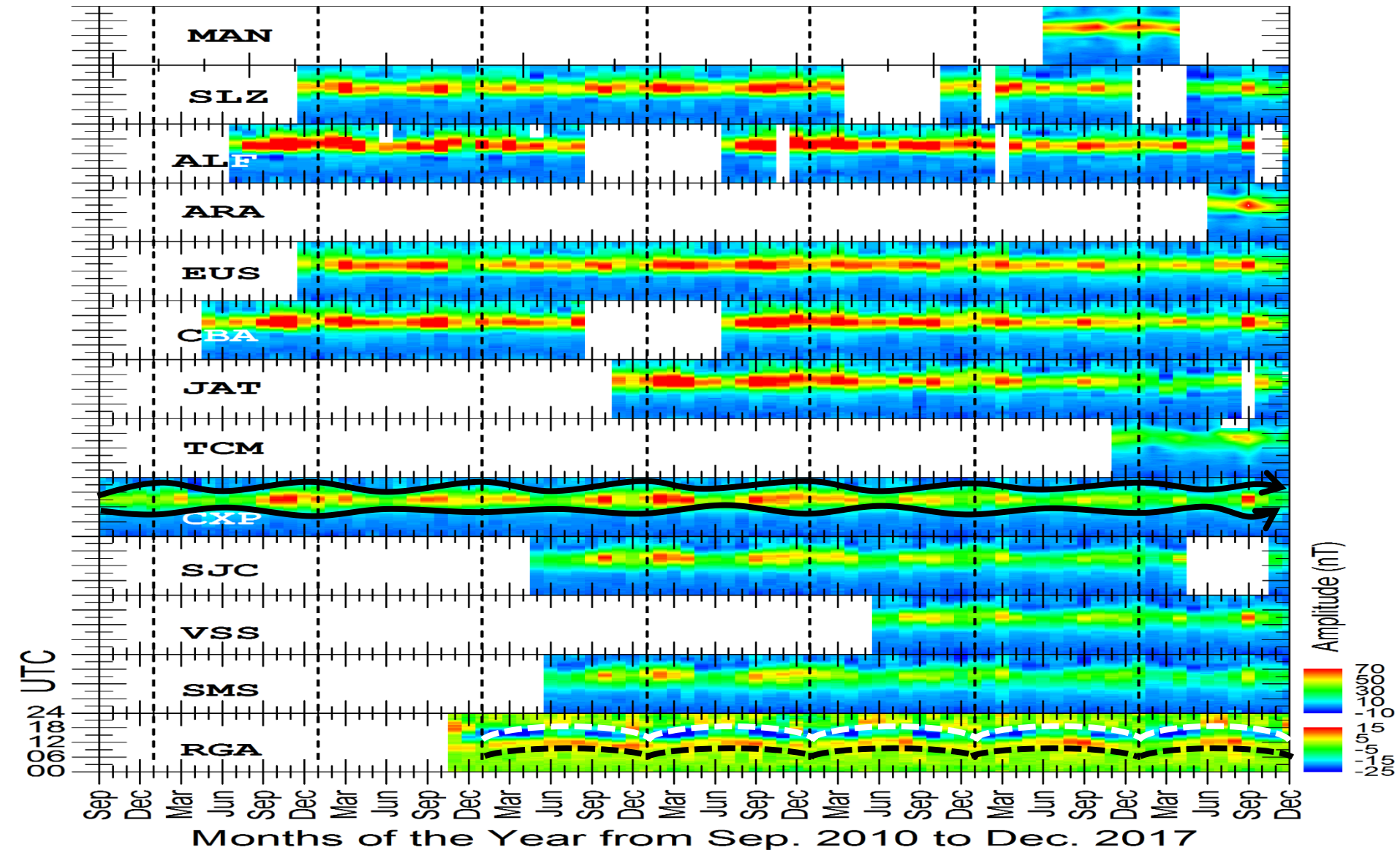


1. Diurnal variation of monthly QDC measured at the Embrace MagNet stations
2. Response of Embrace MagNet to space weather drivers
 - a. *Sudden Storm Commencement (SSC) registered on March 08, 2012*
 - b. *Sudden Impulse (SI) registered on May 21, 2012*
3. Magnetic storms registered on October 12, 2016
4. Flares effects measured by the Embrace MagNet

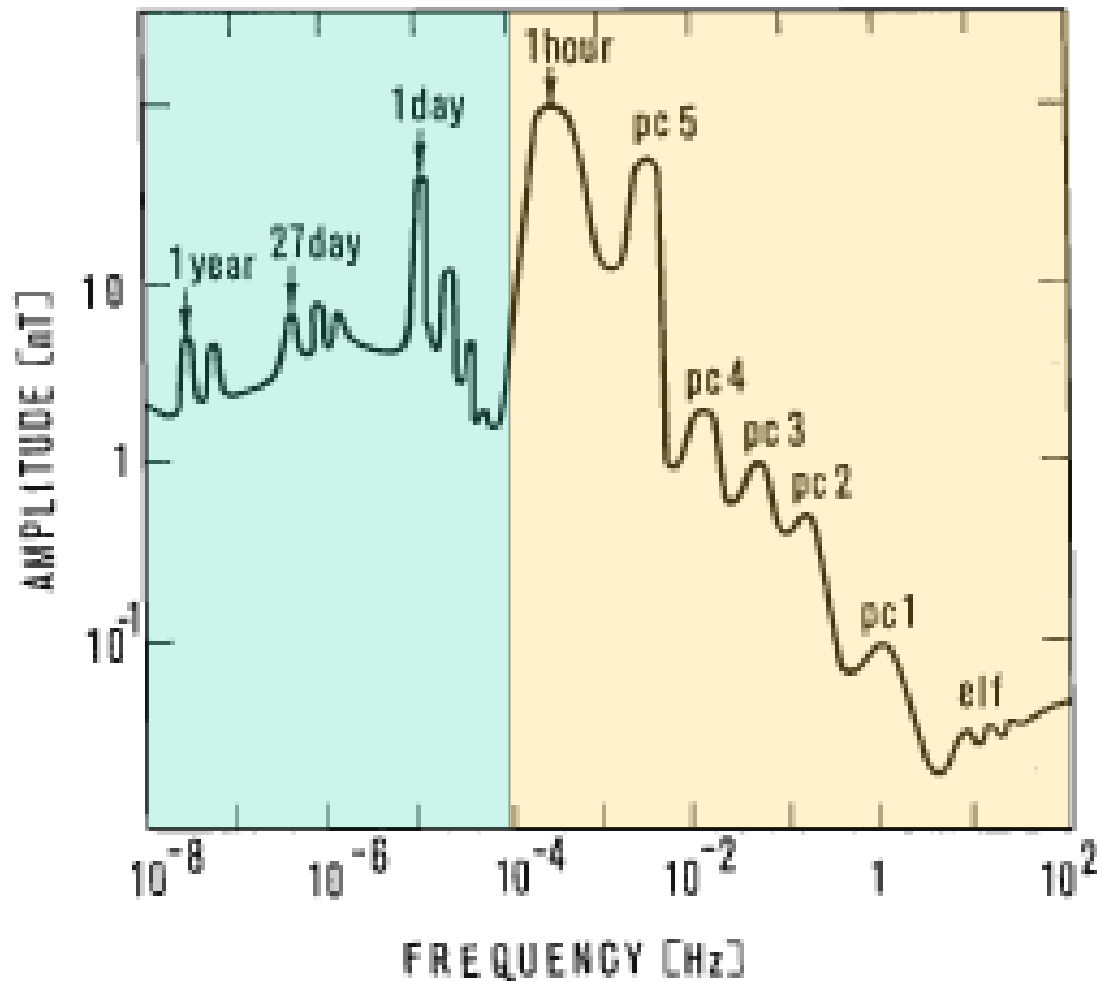


Denardini et al. (2015), Brazilian Journal of Geophysics
"The initial steps for developing the South American k index from the embrace magnetometer network"

QDC for the H Component



Amplitudes of natural variations of the horizontal component H



AFTER: Samson, J.C., (1991). Geomagnetic Pulsations and Plasma Waves in the Earth's Magnetosphere. In: Ed. J.A. Jacobs, Geomagnetism, Vol. 4, Academic Press, London, 481-592.

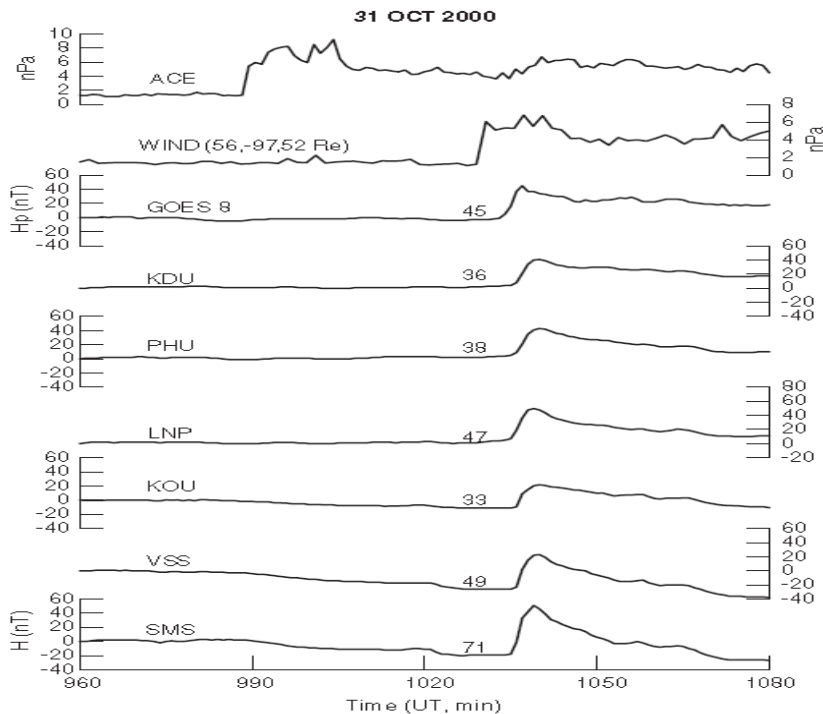


Fig. 1. Portions of H-magnetograms showing sudden impulse recorded at low-latitude stations SMS, VSS, KOU, LNP, PHU, and KDU and in Hp component records at GOES 8 (75°W) at 1713 UT on 31 October 2000. The amplitude of SI at each of the stations is given in nT. Solar wind dynamic pressure measured at ACE and WIND spacecrafts is shown in the top two panels, respectively.

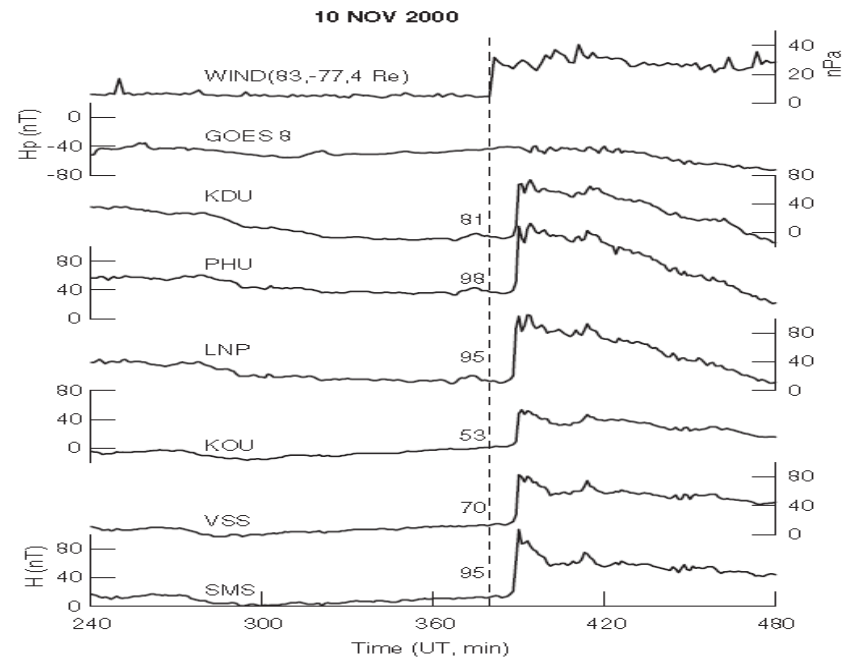
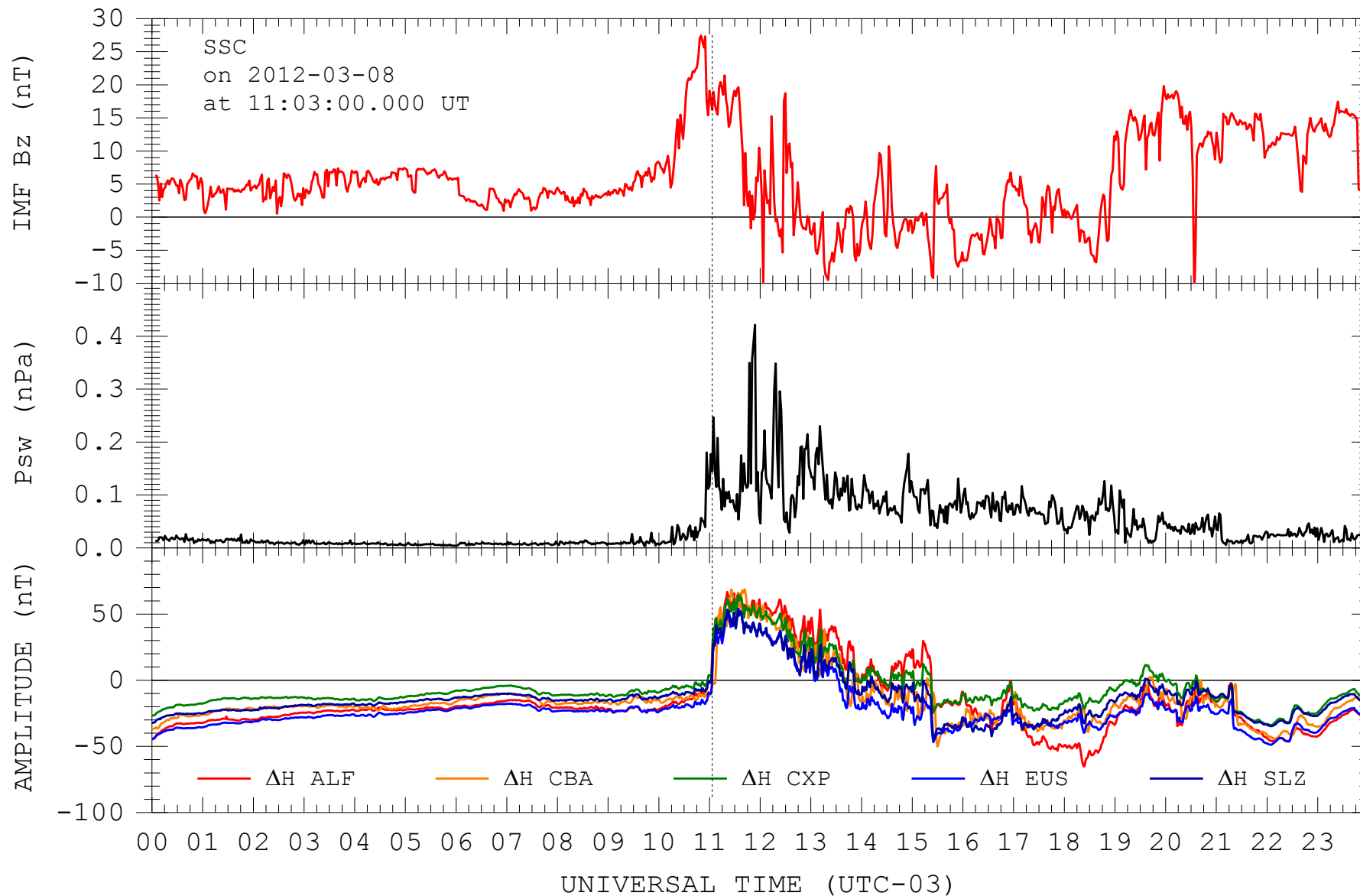
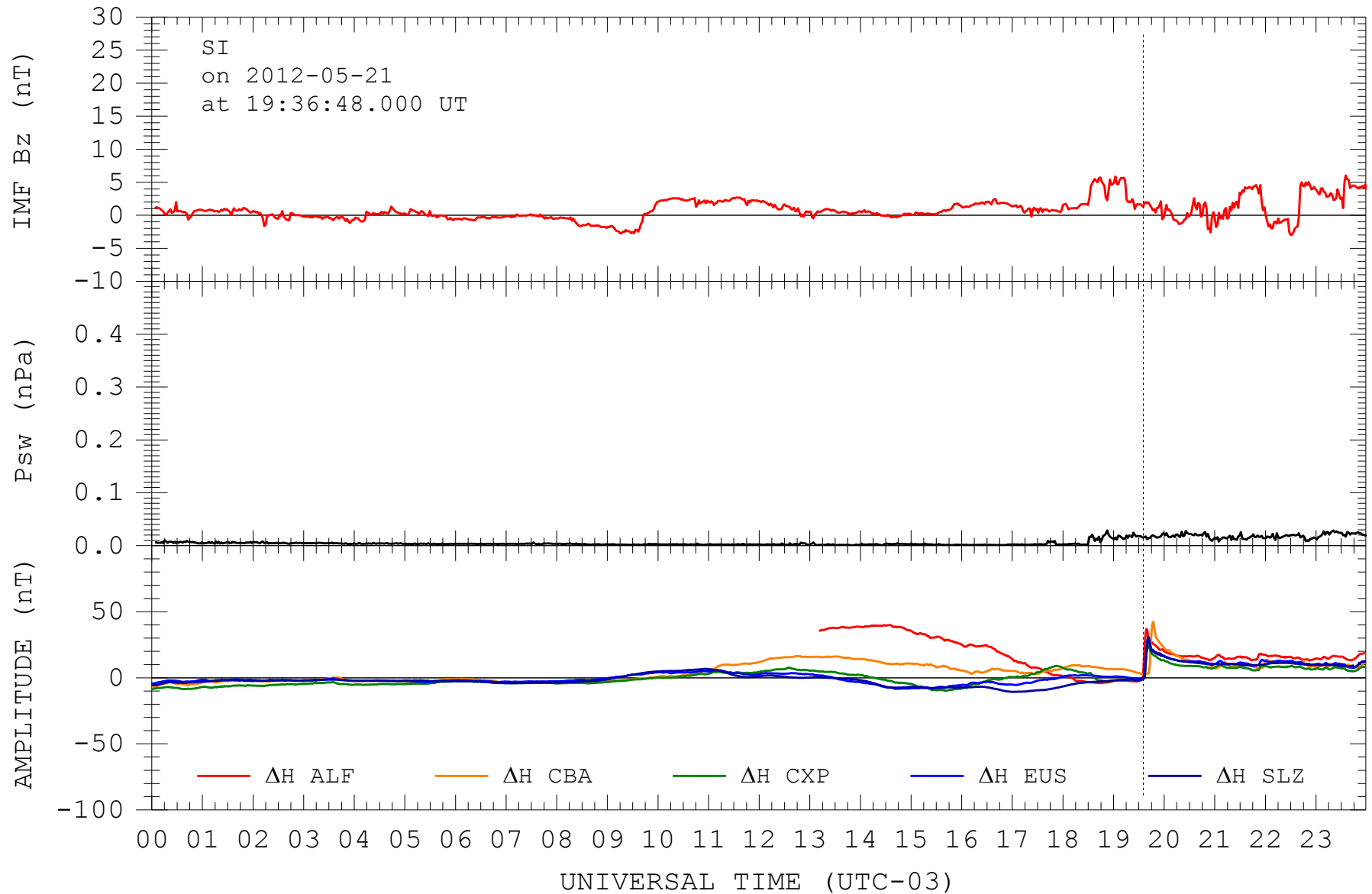


Fig. 2. Portions of H-magnetograms showing sudden impulse recorded at low-latitude stations SMS, VSS, KOU, LNP, PHU, and KDU and in Hp component records at GOES 8 (75°W) at 0623 UT on 10 November 2000. The amplitude of SI at each of the stations is given in nT along with solar wind dynamic pressure measured at WIND spacecraft. ACE measurements were not available on this date.

After: TRIVEDI et al. (2005) *Amplitude enhancement of SC(H) events in the South Atlantic anomaly region*. JASTP. v. 67. p. 1751-1760.

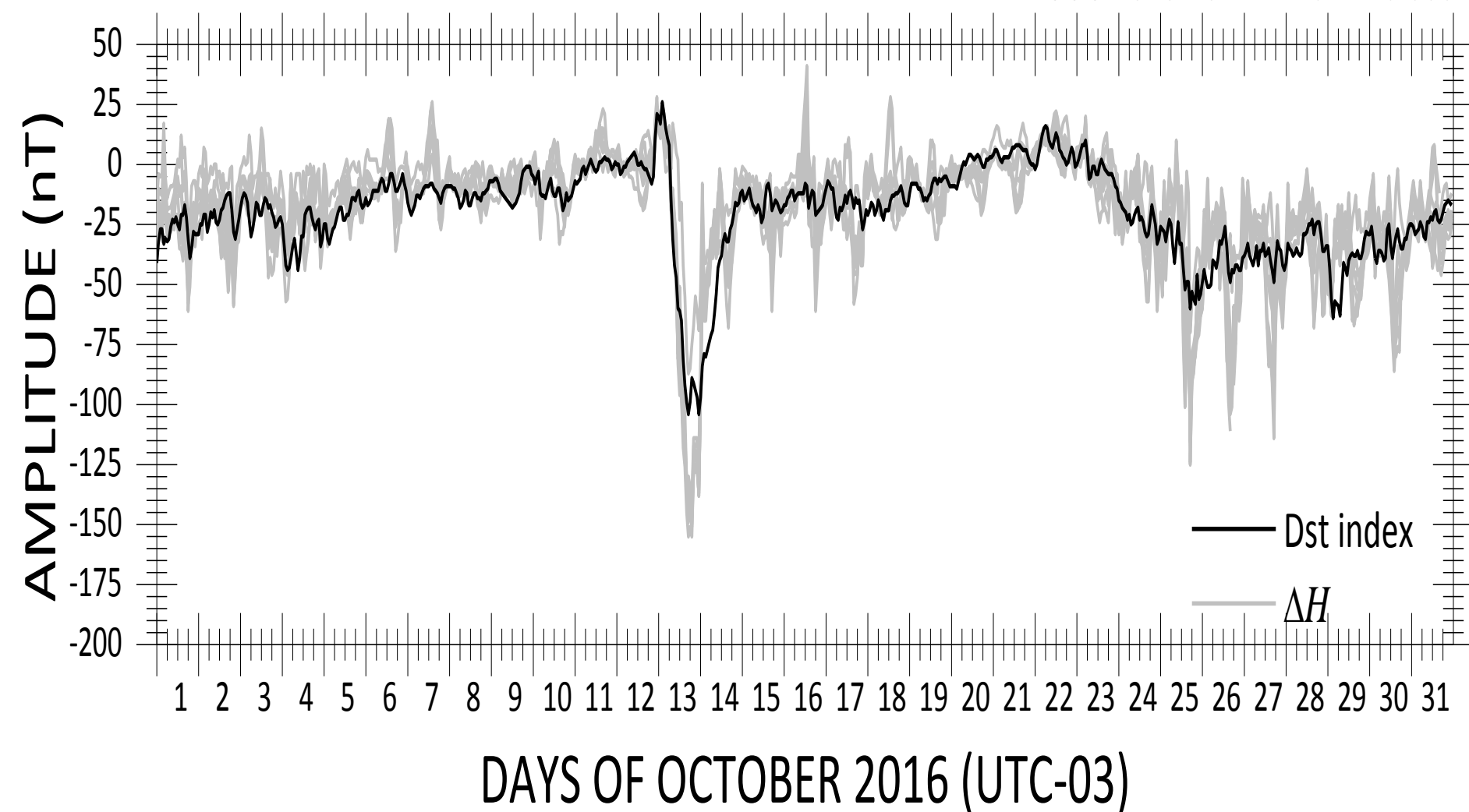
SSC registered on March 08, 2012



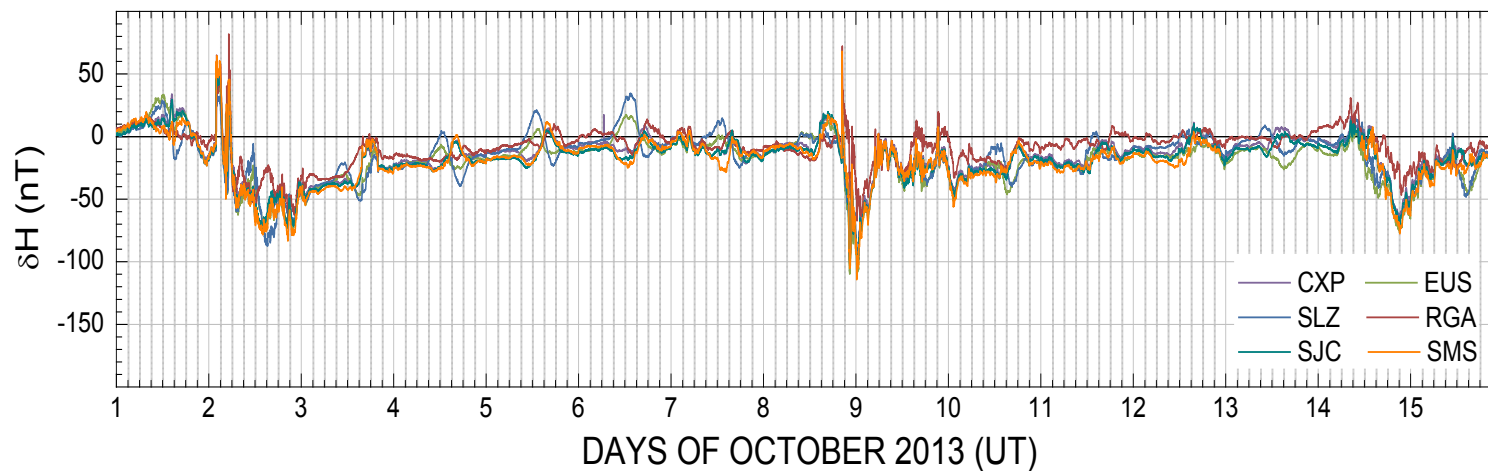
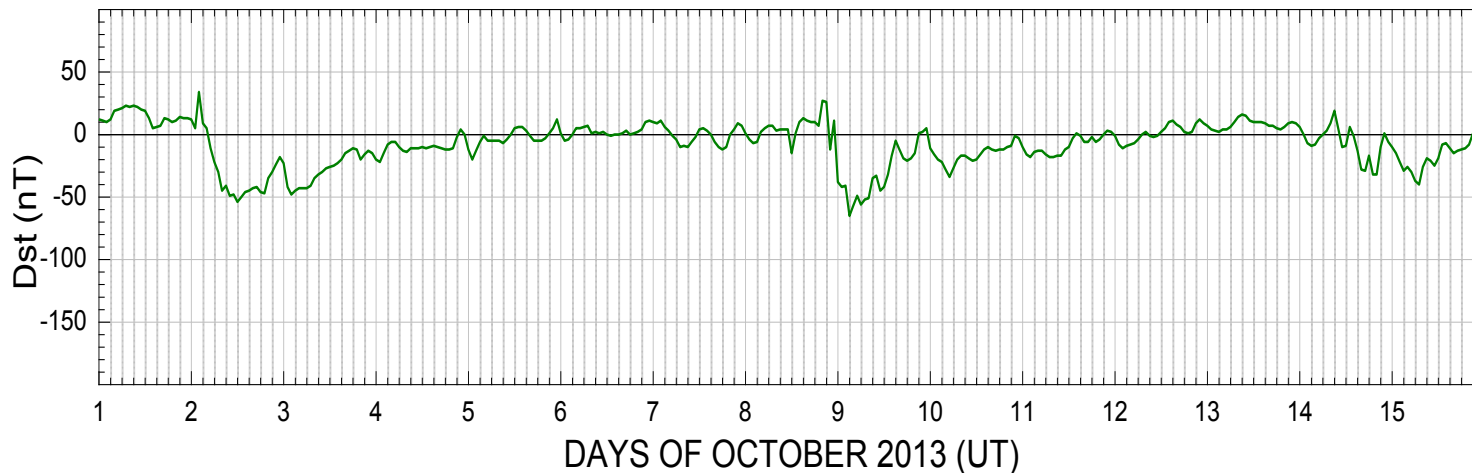


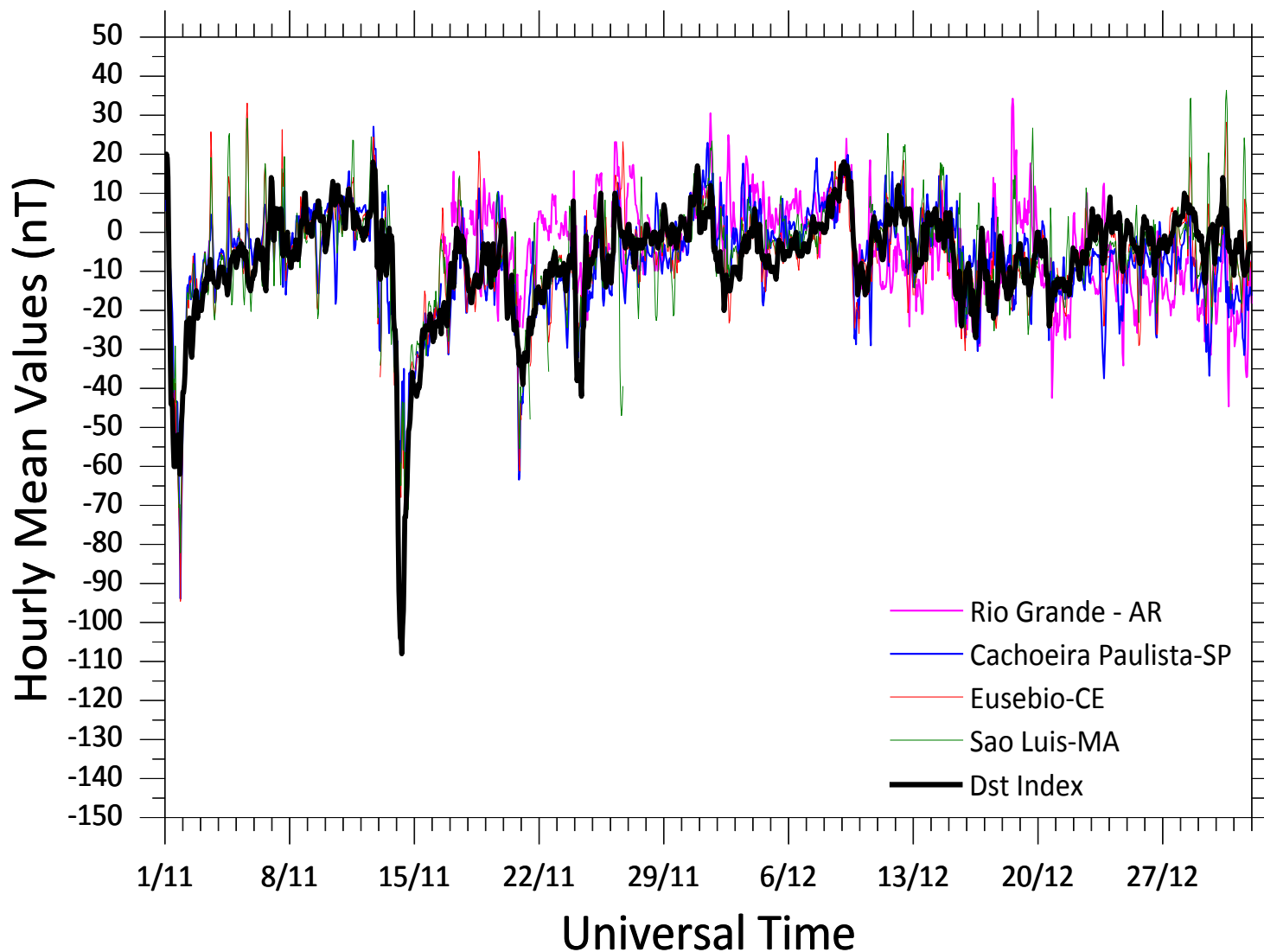
Mag. Storms on Oct. 12, 2016

SSC 2016-10-12 22:01:120.000



01 to 15 OCT 2013

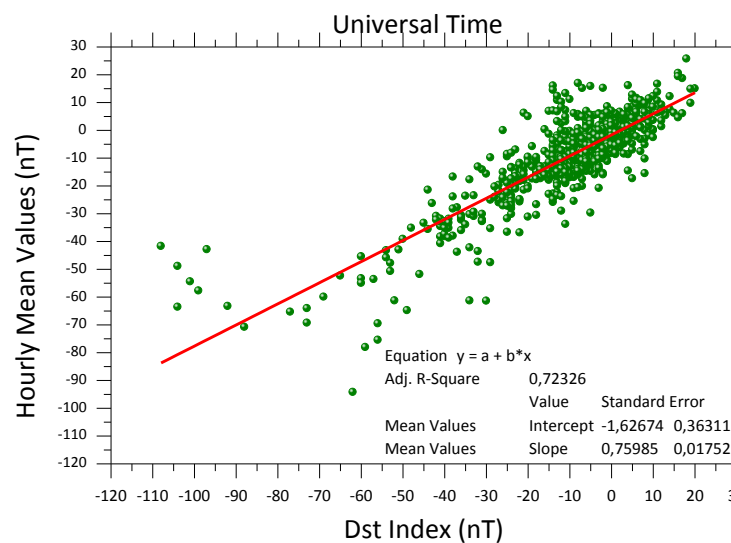
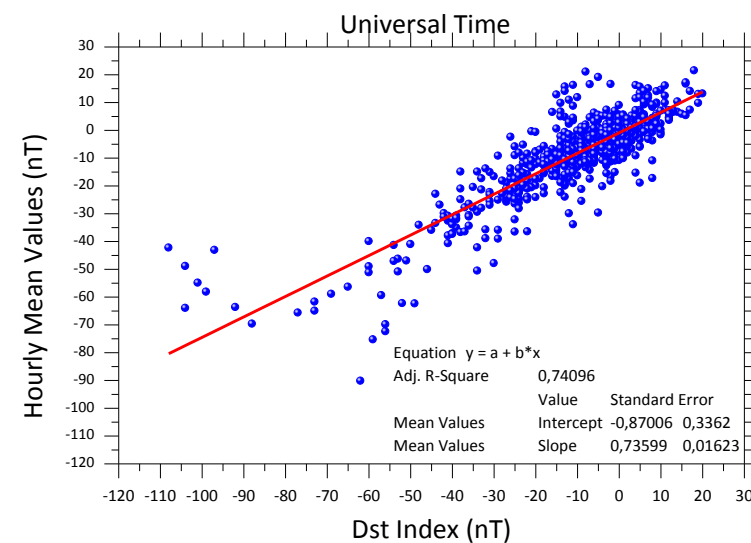
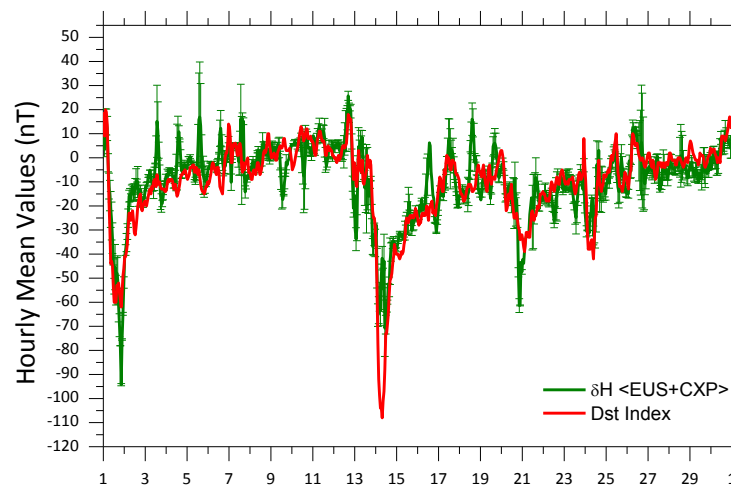
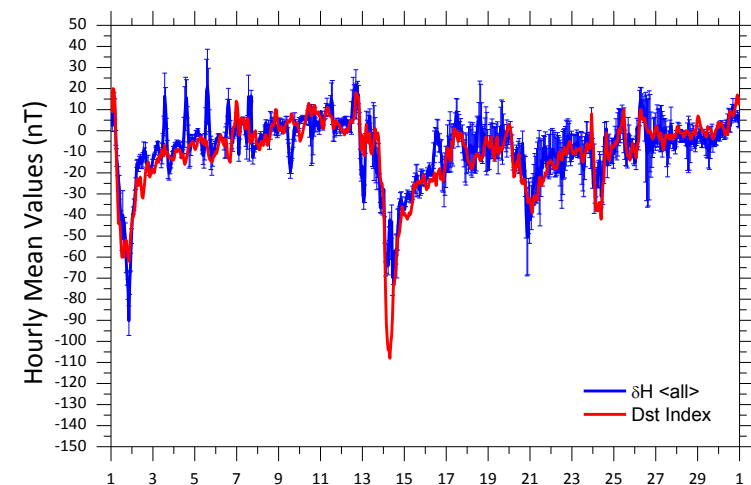




A New Dst Proxy

www.inpe.br/spaceweather

01 to 30 NOV 2012



Localização dos Magnetômetros

Google

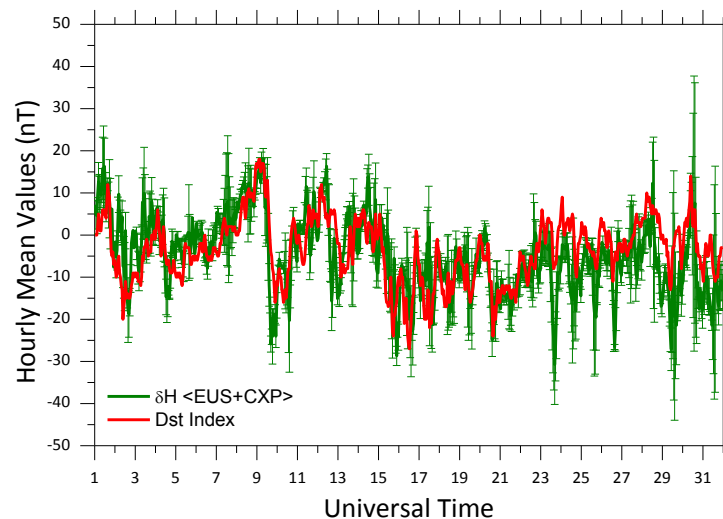
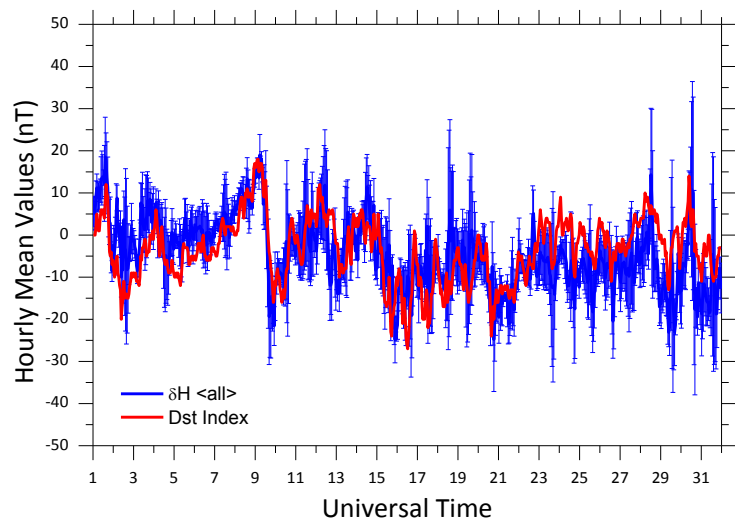
Termos de Uso

Listagem

- ▶ Cuiabá, CBA
- ▶ Alta Floresta, AFT
- ▶ Cachoeira Paulista, CXP
- ▶ Eusébio, EUS
- ▶ São Luís, SLZ
- ▶ Rio Grande - Argentina, RGA
- ▶ São José dos Campos, SJC
- ▶ São Martinho da Serra, SMS

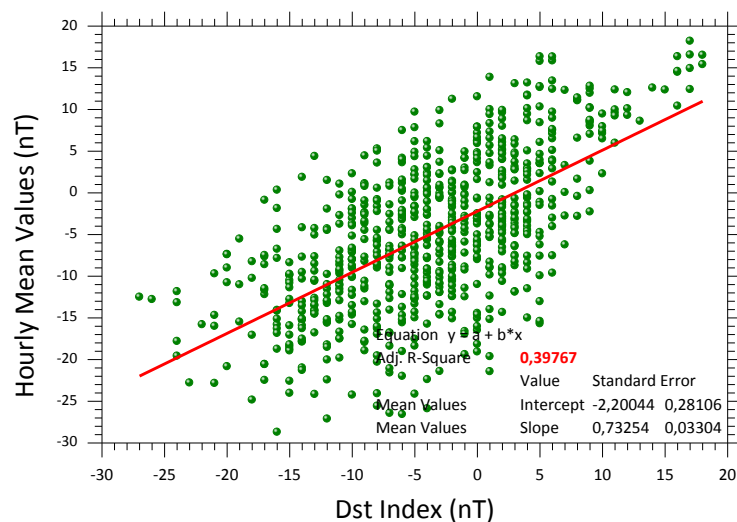
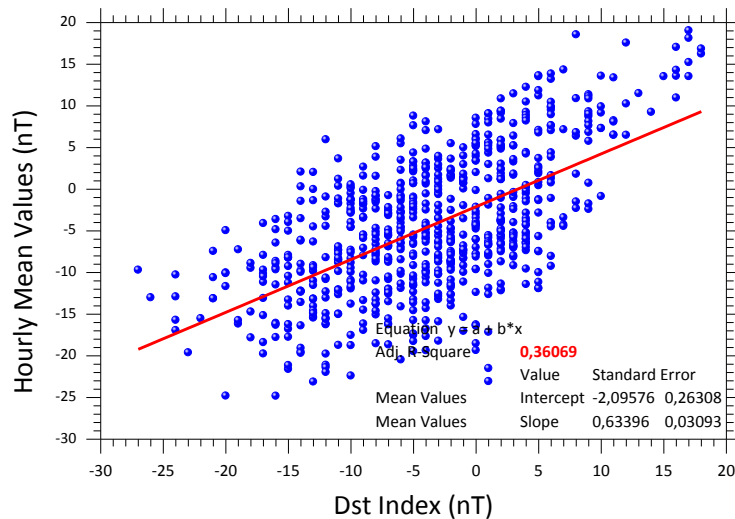
A New Dst Proxy

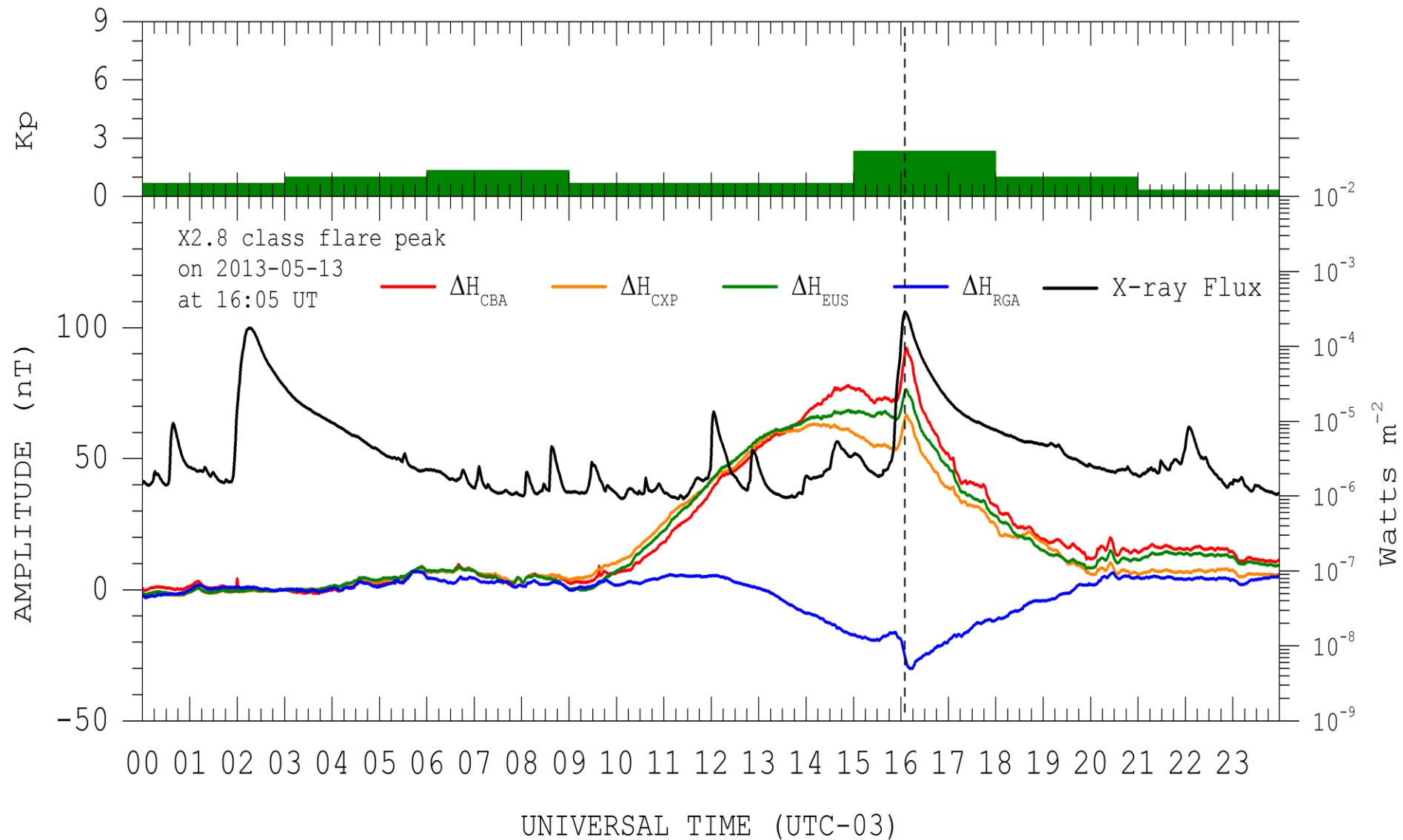
01 to 31 DEC 2012

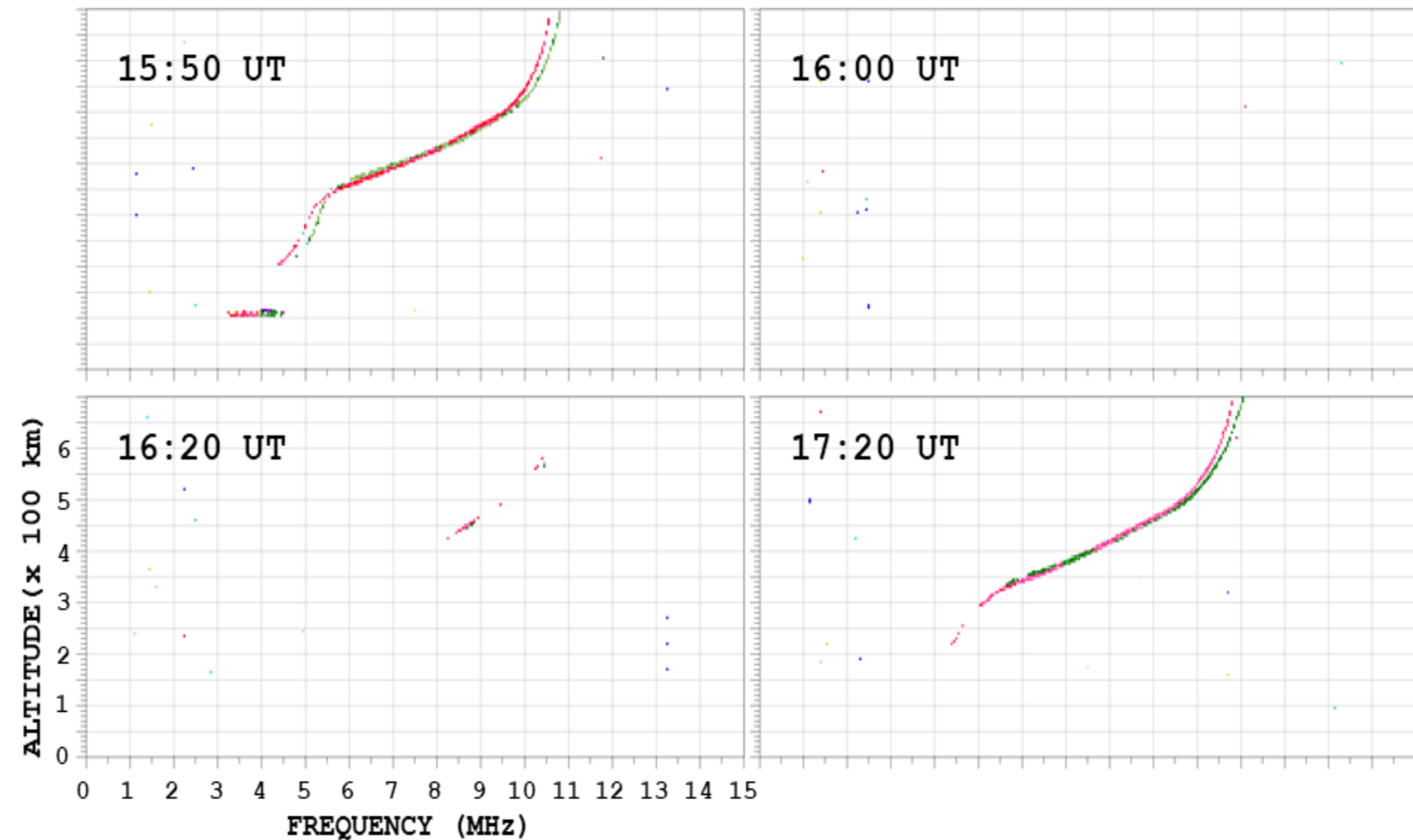


Listagem

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- ▶ Cachoeira Paulista, CXP
- ▶ Eusébio, EUS
- ▶ São Luís, SLZ
- ▶ Rio Grande - Argentina, RGA
- ▶ São José dos Campos, SJC
- ▶ São Martinho da Serra, SMS

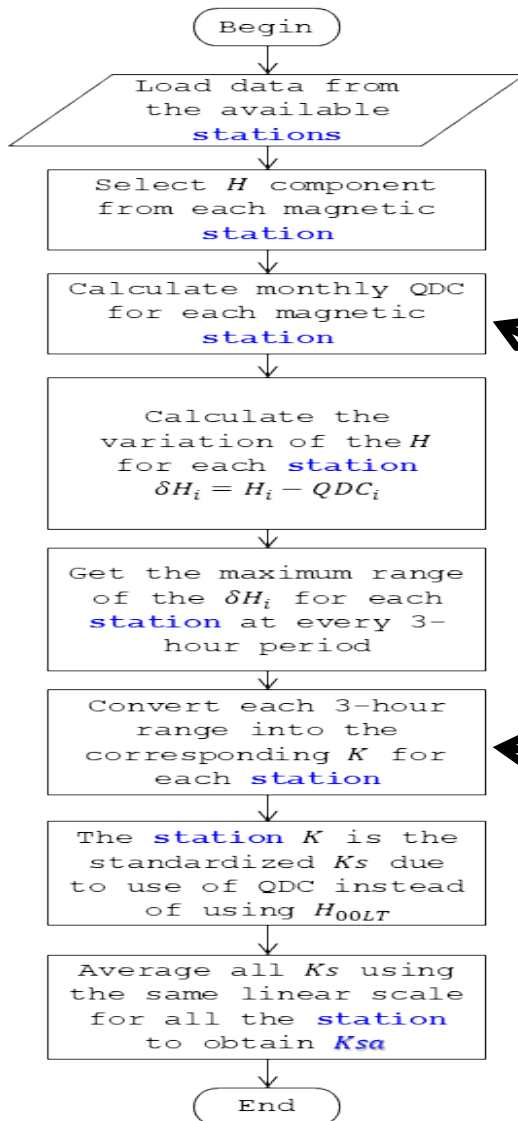




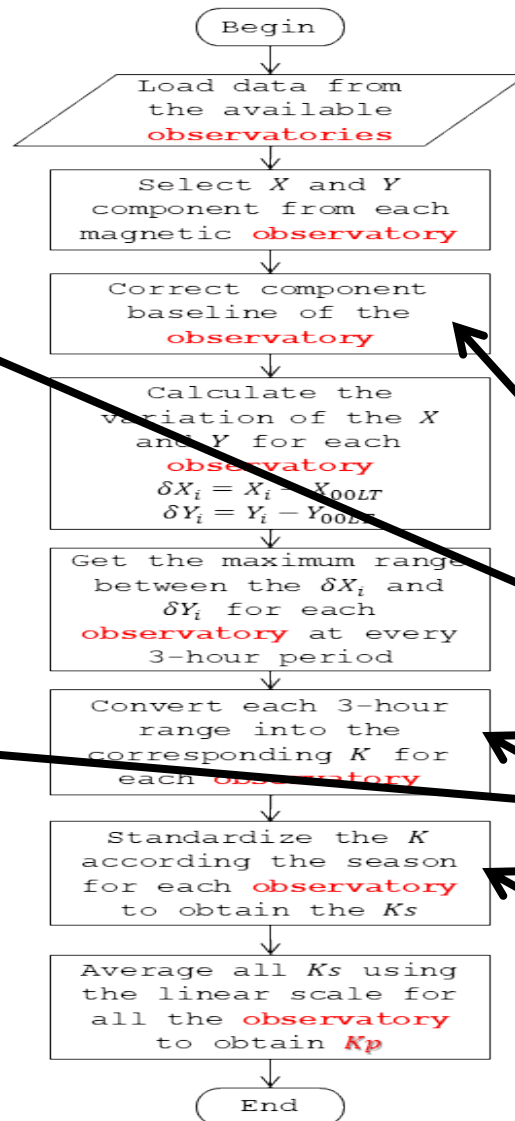


1. The algorithm
2. Defining the K9 lower limit
3. The magnetic station K
4. The South American Index (Ksa)
5. Some comparison with the Kp
 - a. Time evolution
 - b. Linear fit
6. Where the differences comes from ?
(Data vs Algorithm)
7. Samples of its use

K_{sa}



K_p



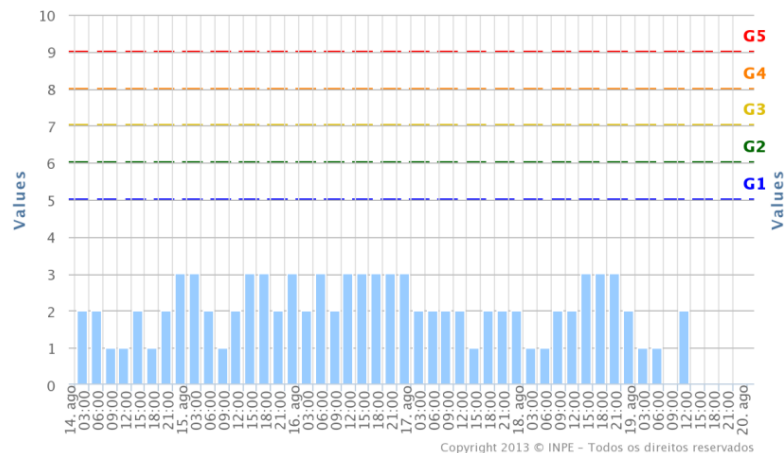
INPUTS

1. LOCAL baseline for all the magnetic components
2. LOCAL Quiet Day Curve for the horizontal component
3. LOCAL table for getting the range into K
4. LOCAL table for standardize the K into Ks

www.inpe.br/spaceweather

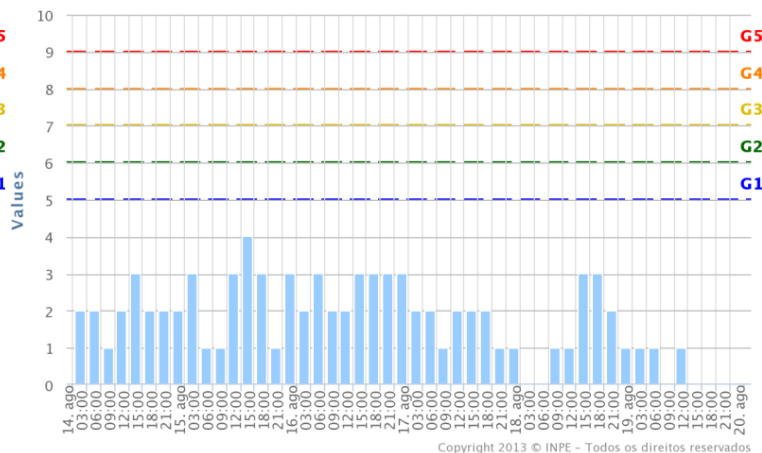
Rede EMBRACE de Magnetômetros

Índice K - São José dos Campos - (14/08/2013 - 19/08/2013)



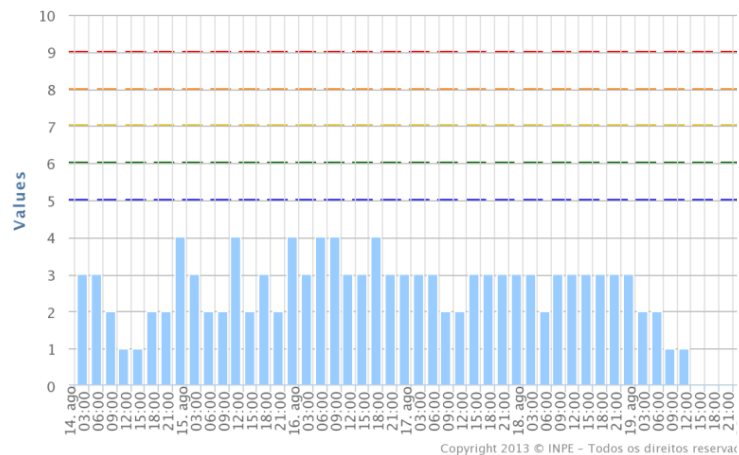
Rede EMBRACE de Magnetômetros

Índice K - São Luís - (14/08/2013 - 19/08/2013)



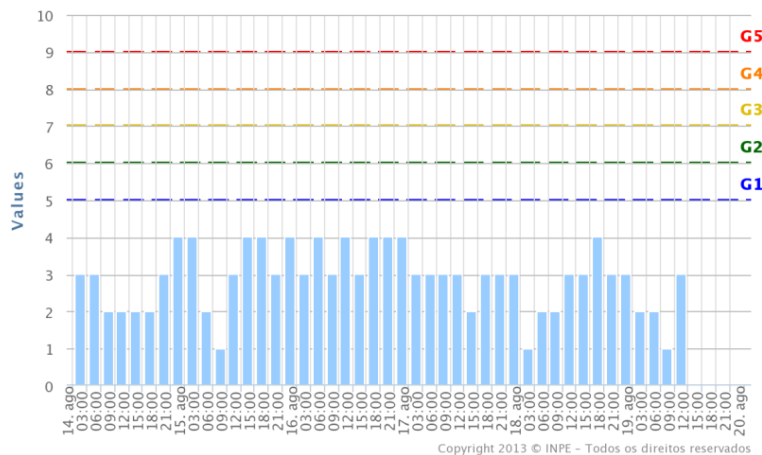
Rede EMBRACE de Magnetômetros

Índice K - Rio Grande - Argentina - (14/08/2013 - 19/08/2013)



Rede EMBRACE de Magnetômetros

Índice K - Cachoeira Paulista - (14/08/2013 - 19/08/2013)



Localização dos Magnetômetros

Google
Termos de Uso

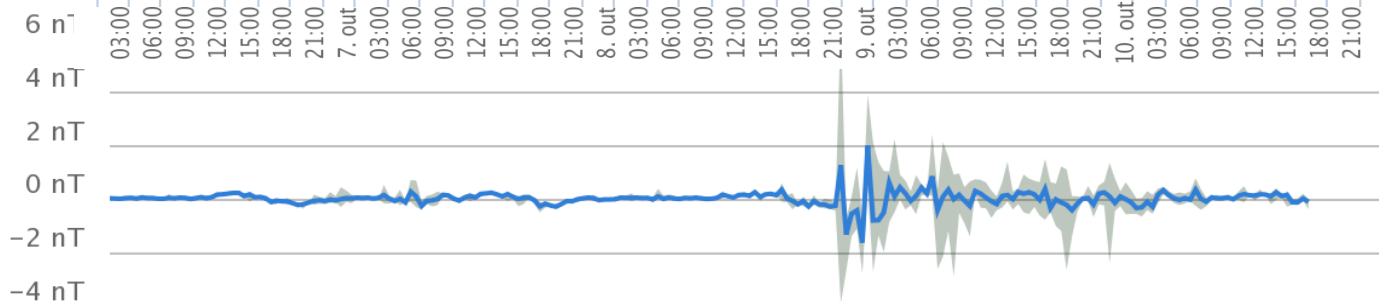
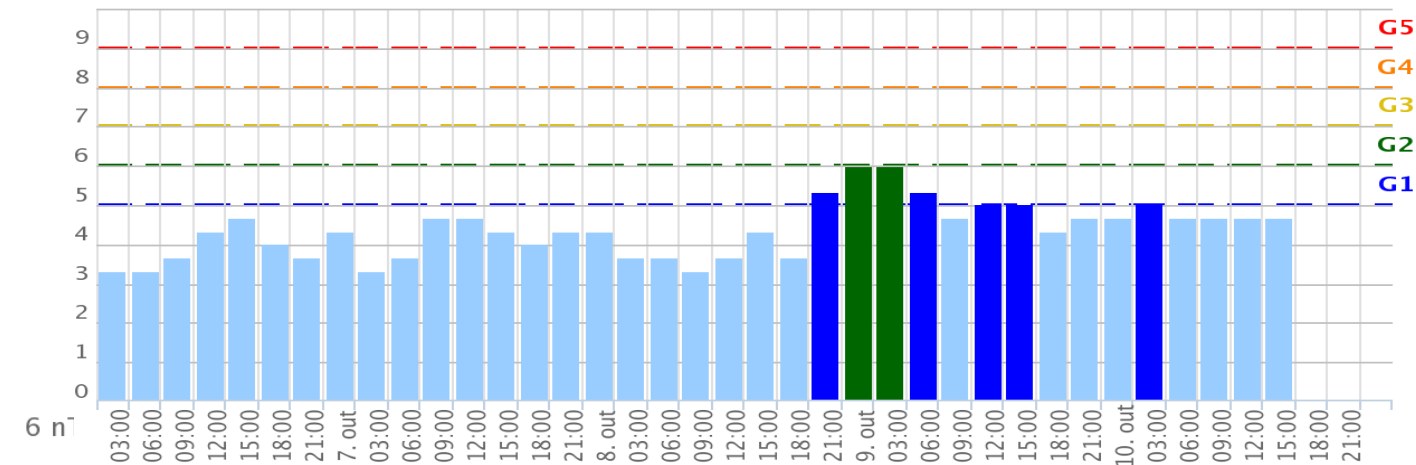
Listagem

- ▶ Cuiabá, CBA
- ▶ Alta Floresta, AFT
- ▶ Cachoeira Paulista, CXP
- ▶ Eusébio, EUS
- ▶ São Luís, SLZ
- ▶ Rio Grande - Argentina, RGA
- ▶ São José dos Campos, SJC
- ▶ São Martinho da Serra, SMS

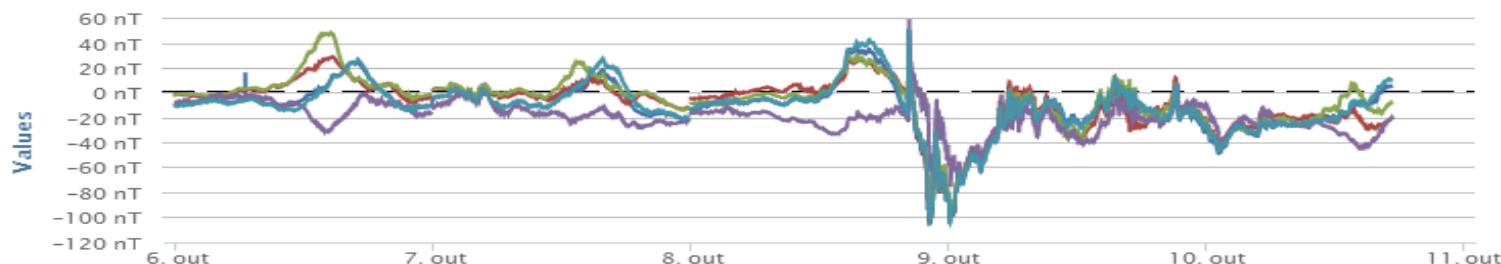
A New Dst Proxy

de 06 a 10 OCT 2013

Rede EMBRACE de Magnetômetros
Índice Ksa - (06/10/2013 - 10/10/2013)



Rede EMBRACE de Magnetômetros
 ΔH - (06/10/2013 - 10/10/2013)



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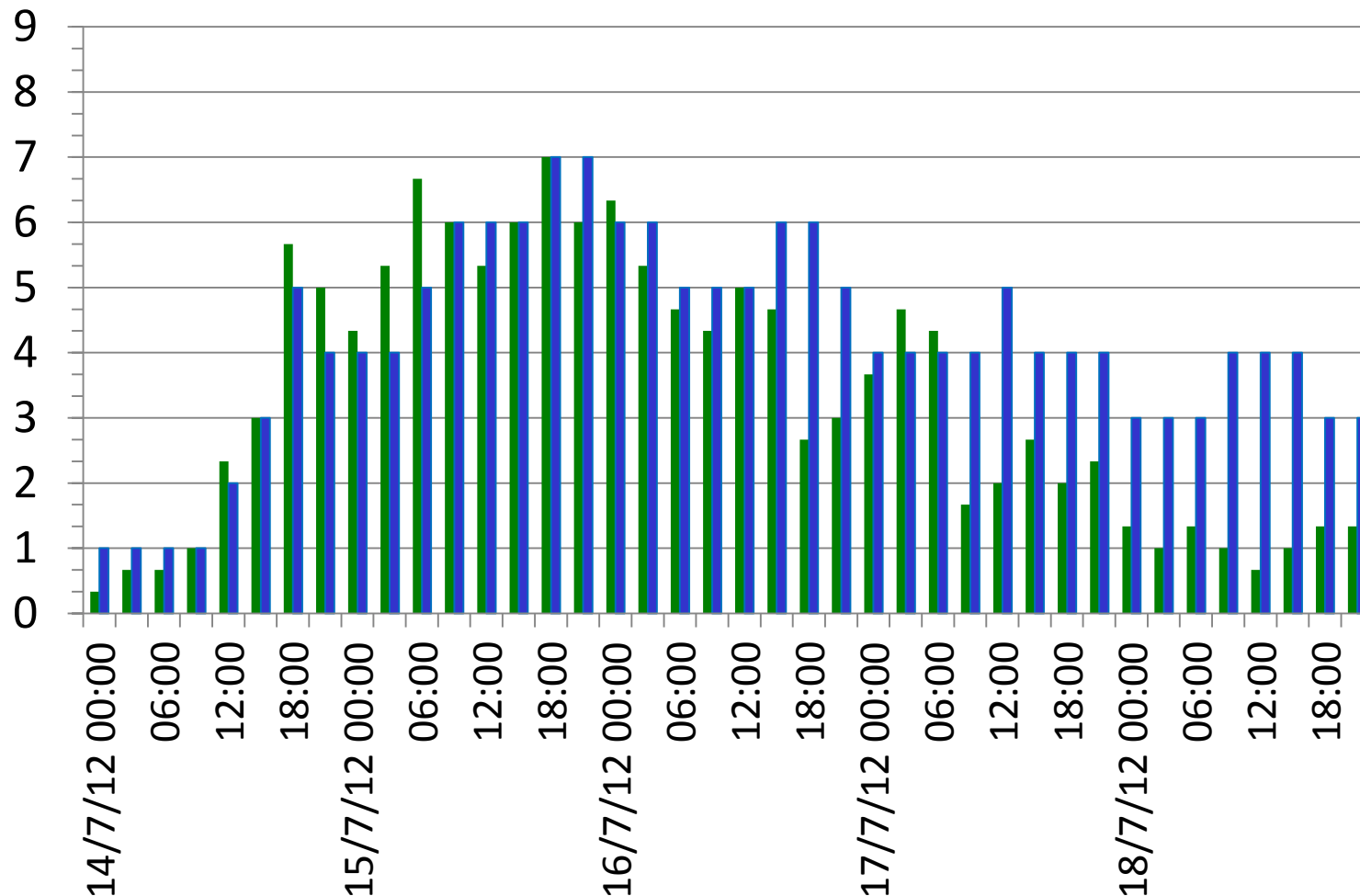
Localização dos Magnetômetros

Listagem

- ▶ Cuiabá, CBA
- ▶ Alta Floresta, AFT
- ▶ Cachoeira Paulista, CXP
- ▶ Eusébio, EUS
- ▶ São Luís, SLZ
- ▶ Rio Grande - Argentina, RGA
- ▶ São José dos Campos, SJC
- ▶ São Martinho da Serra, SMS

■ Kp

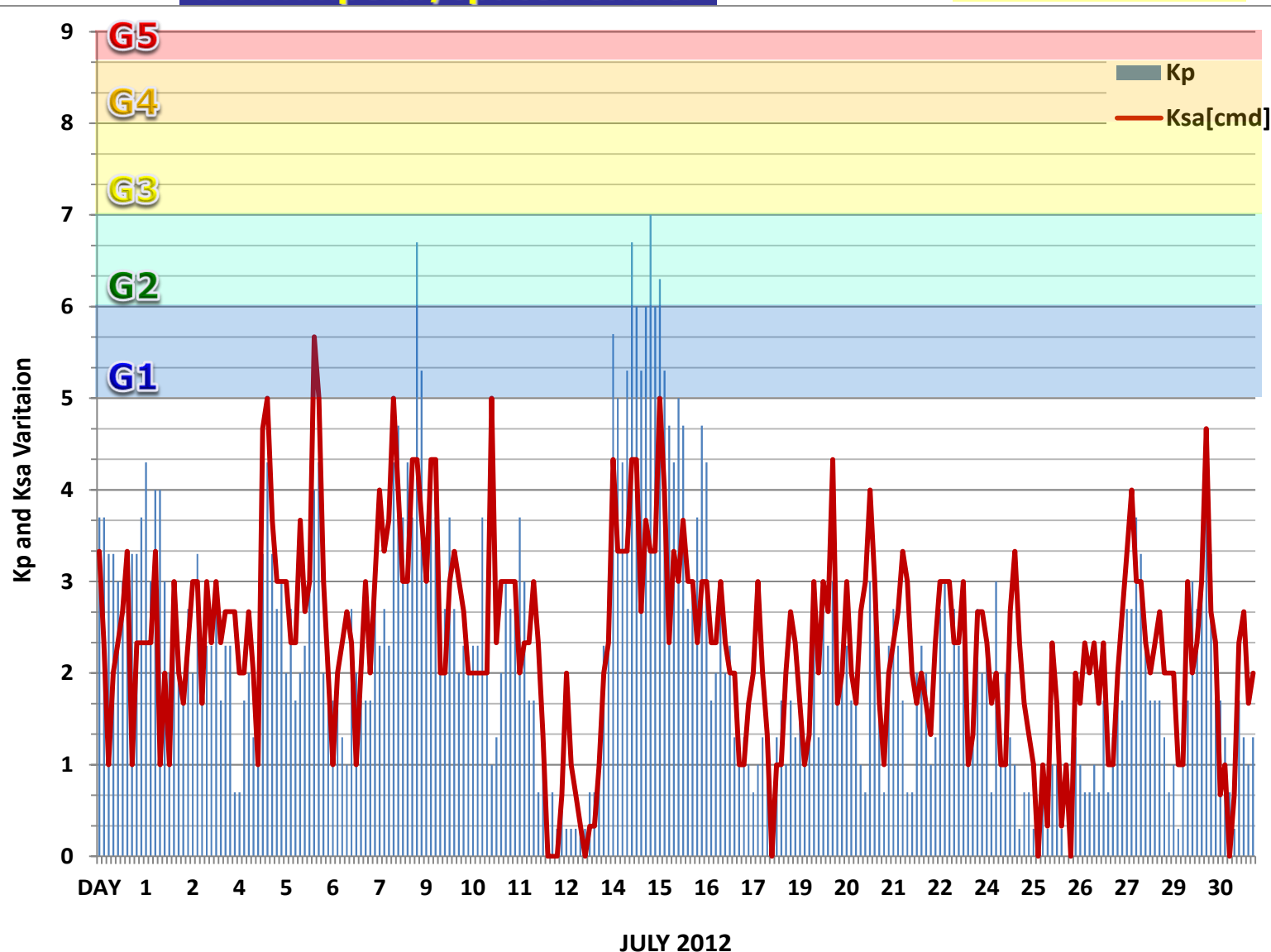
■ Ksa



Localização dos Magnetômetros

Listagem

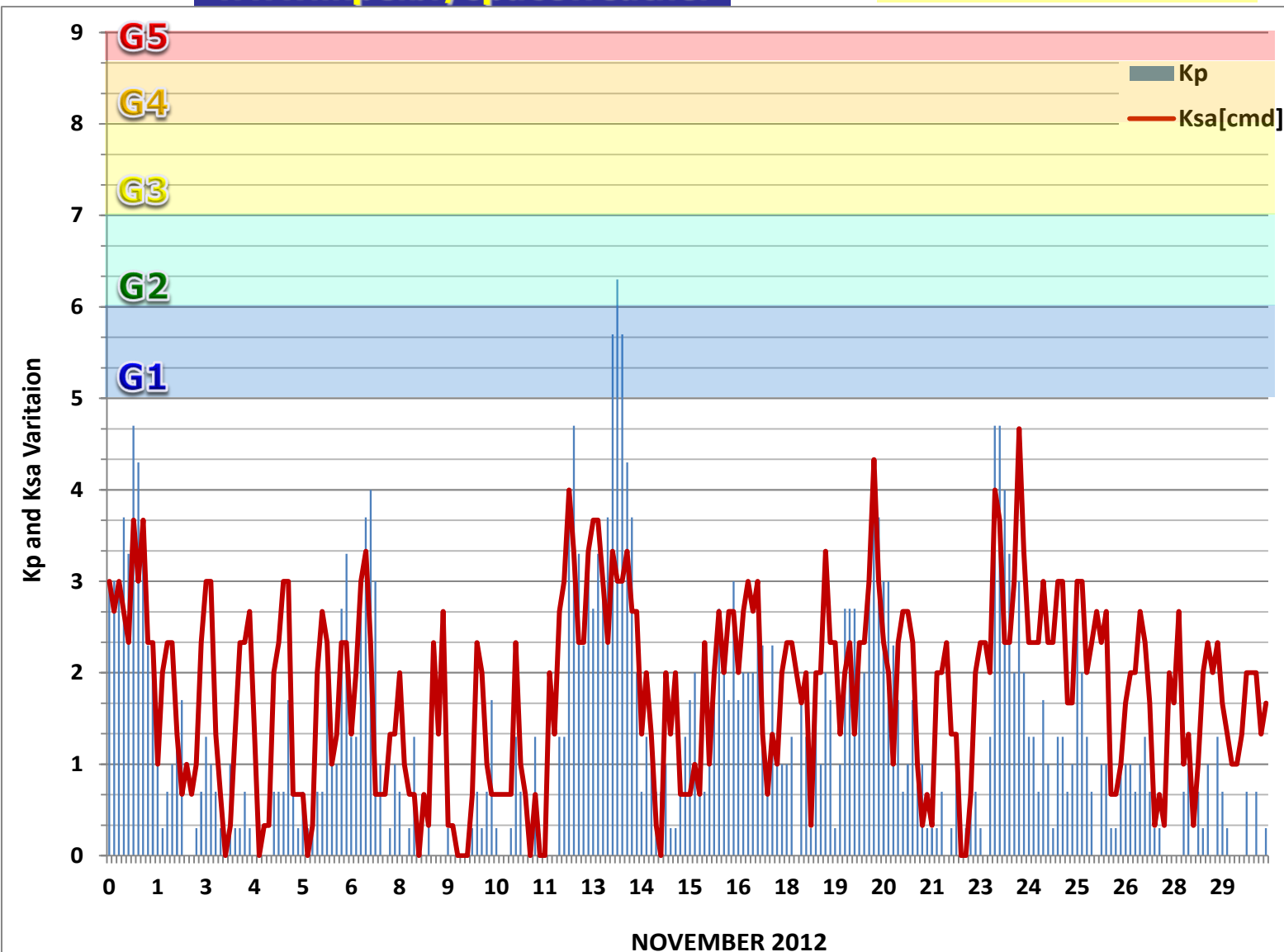
- ▶ Cuiabá, CBA
- ▶ Alta Floresta, AFT
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- ▶ São José dos Campos, SJC
- ▶ São Martinho da Serra, SMS

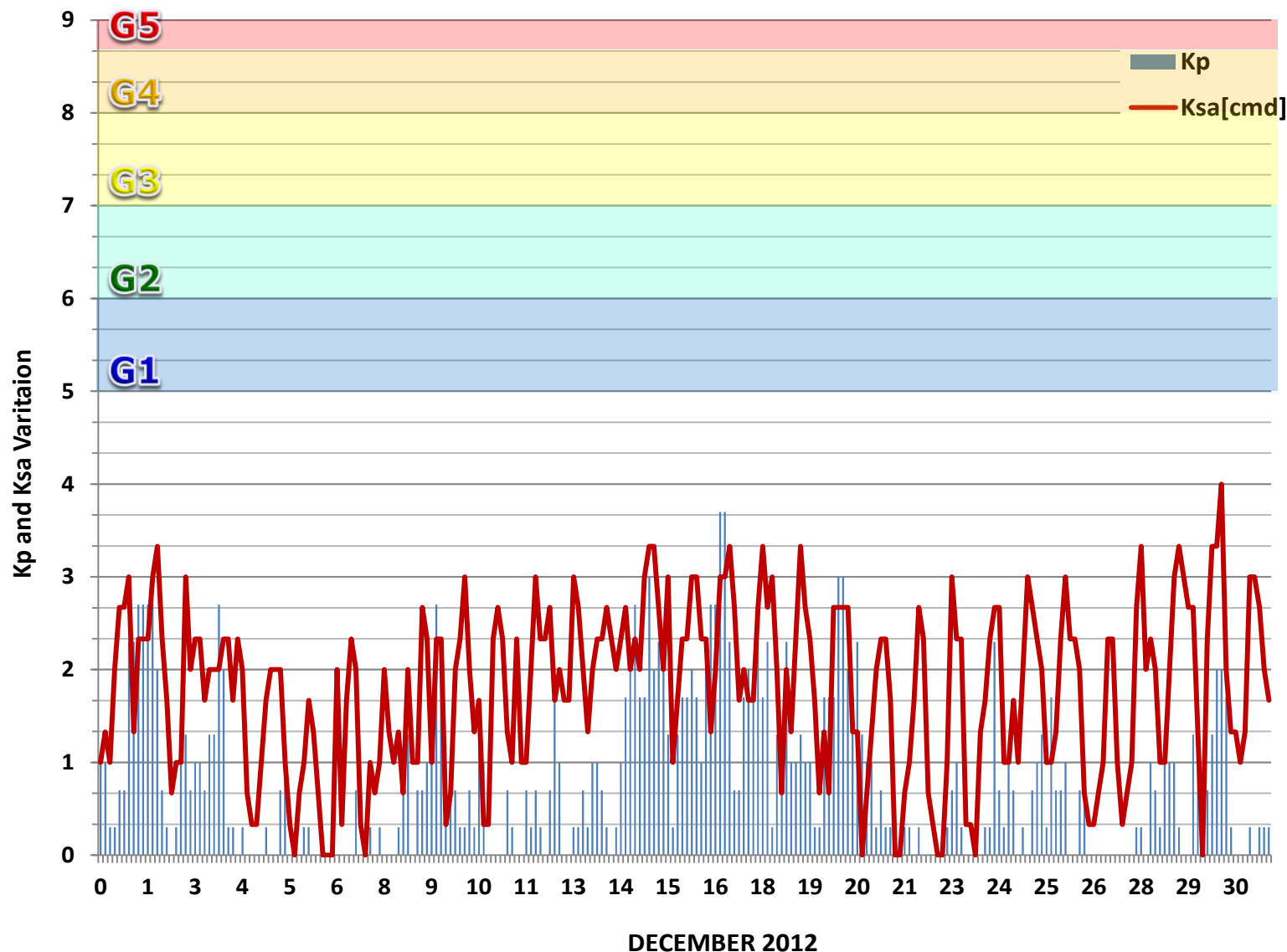


Localização dos Magnetômetros

Listagem

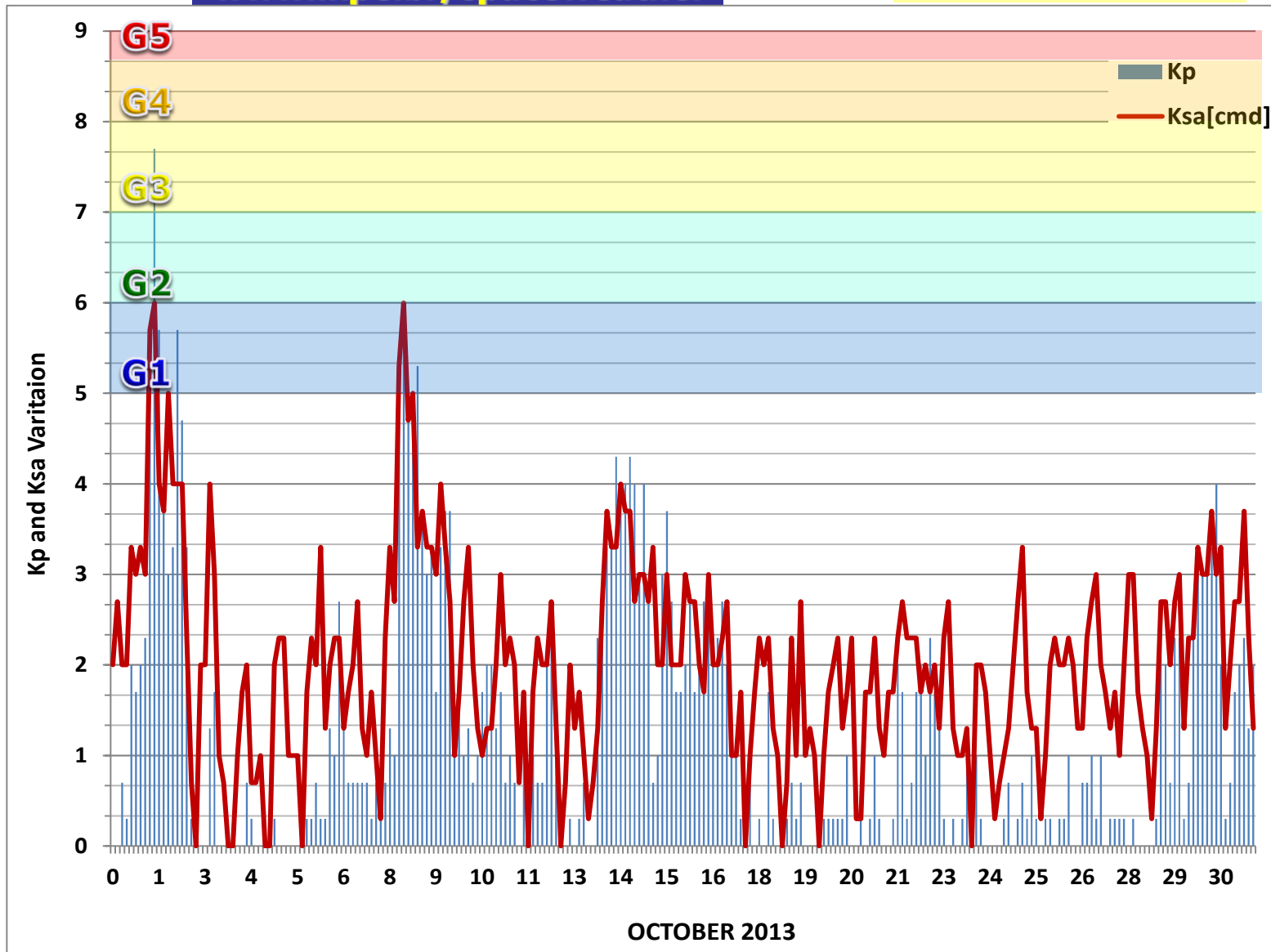
- ▶ Cuiabá, CBA
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- ▶ Rio Grande - Argentina, RGA
- ▶ São José dos Campos, SJC
- ▶ São Martinho da Serra, SMS

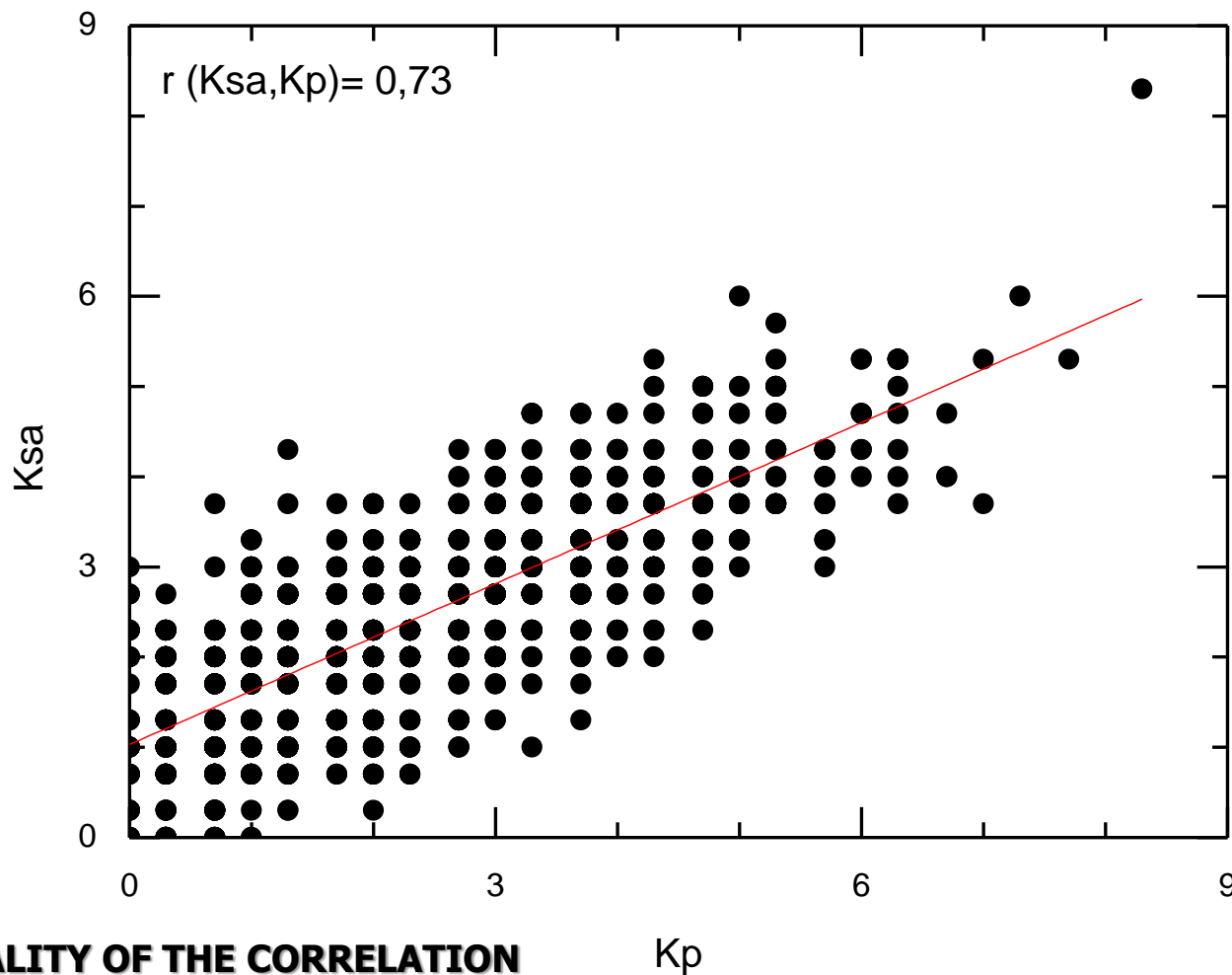




www.inpe.br/spaceweather

01 to 31 OCTOBER 2013





QUALITY OF THE CORRELATION

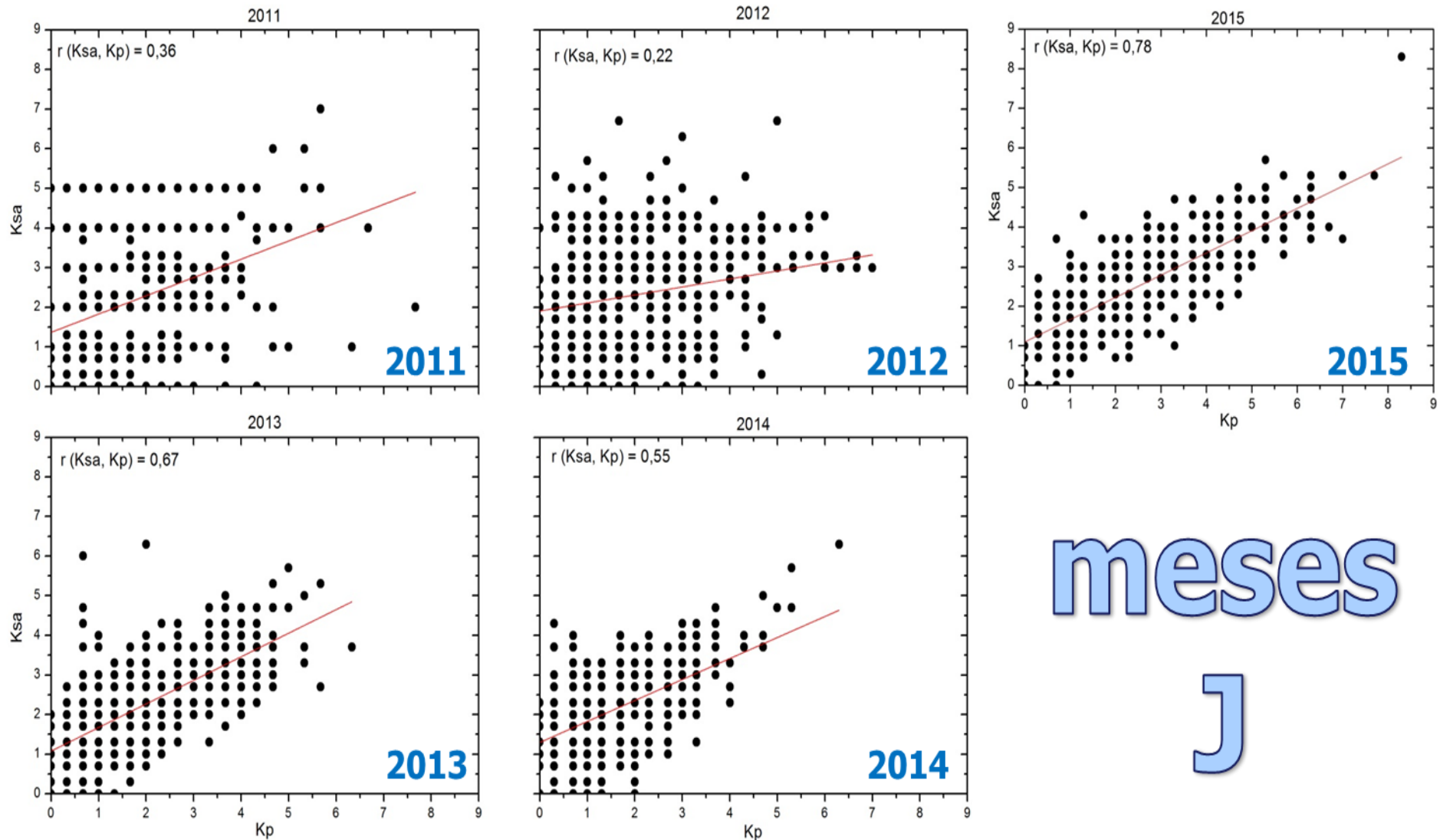
Weak	0.1	0.4
Moderate	0.4	0.7
Strong	0.7	1.0

DANCEY and REIDY (2006).

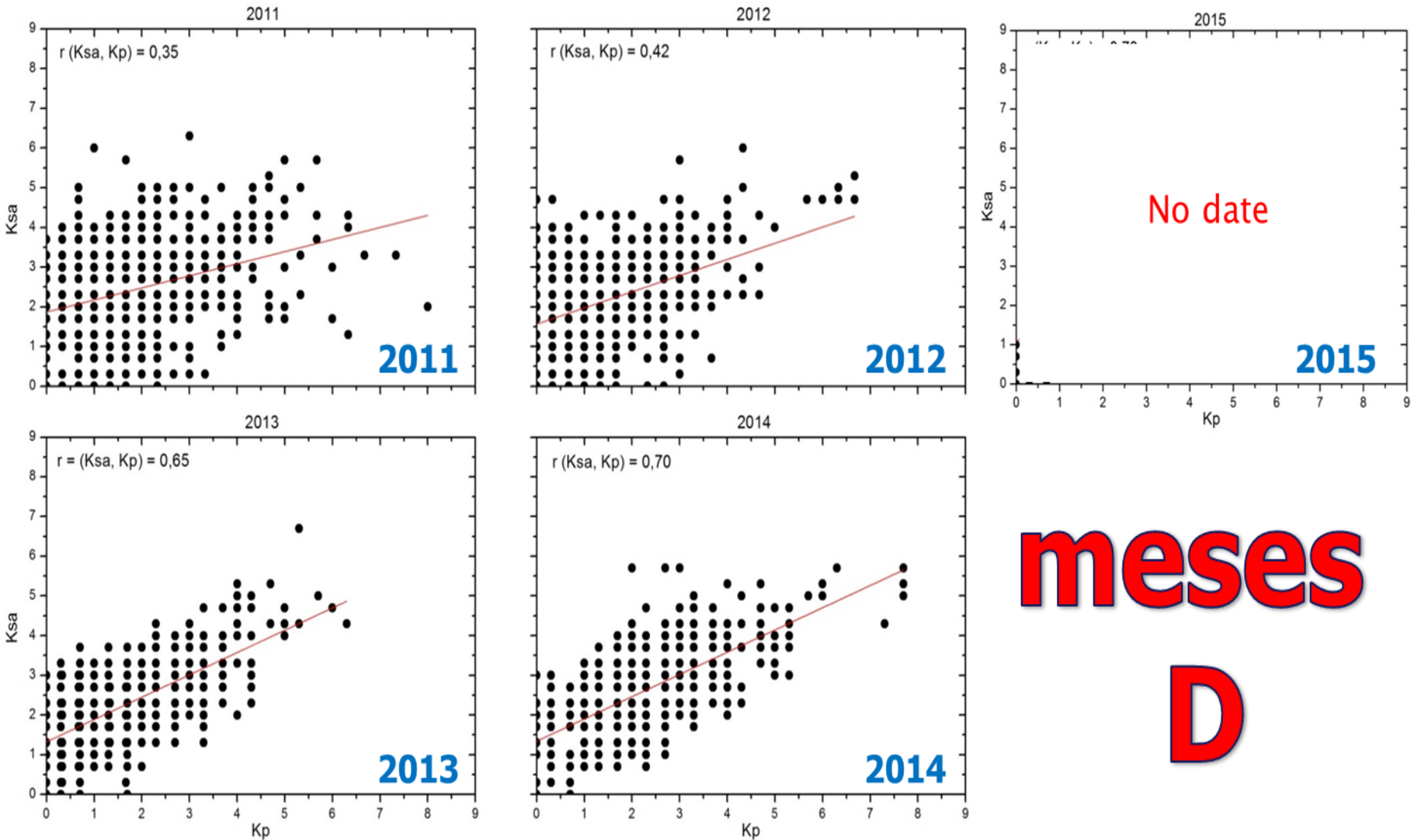
The South American K Index

www.inpe.br/spaceweather

2011 to 2015



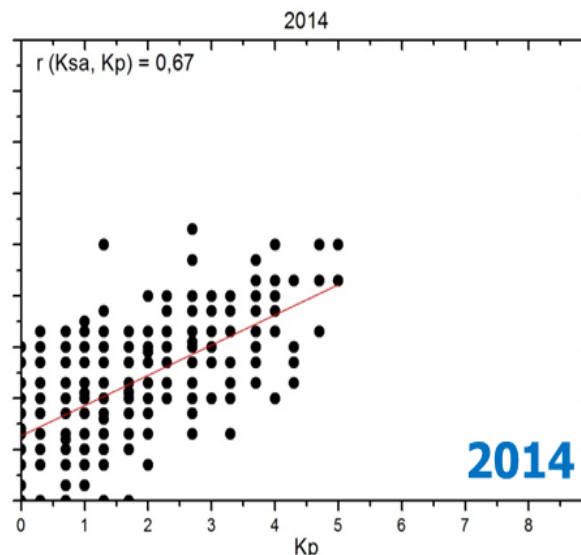
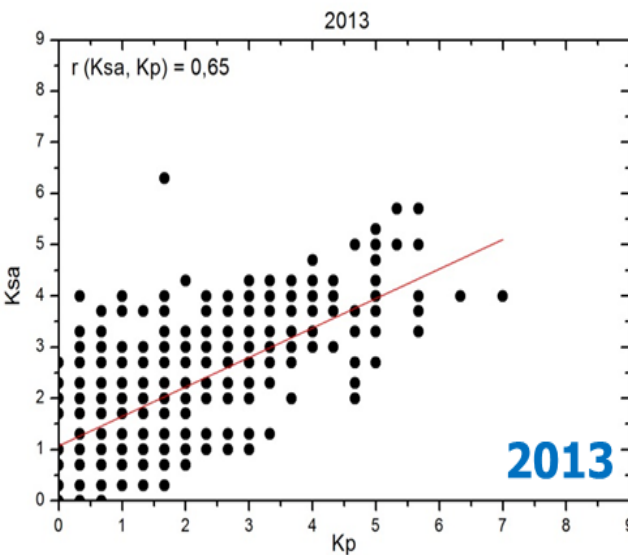
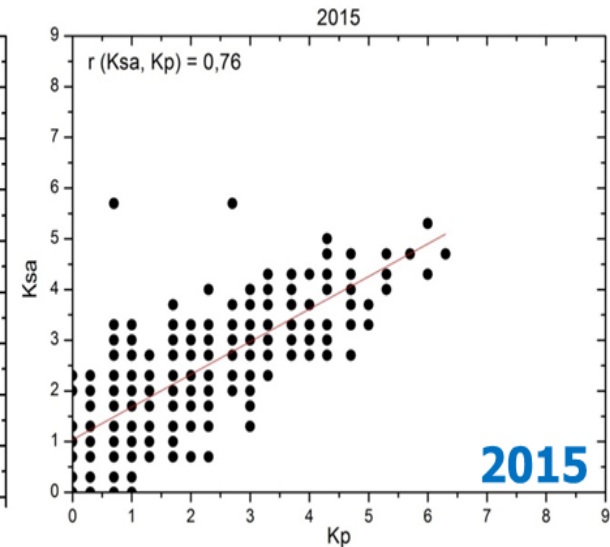
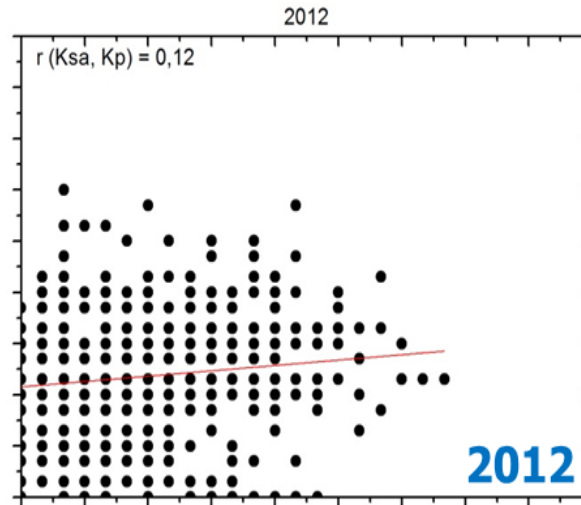
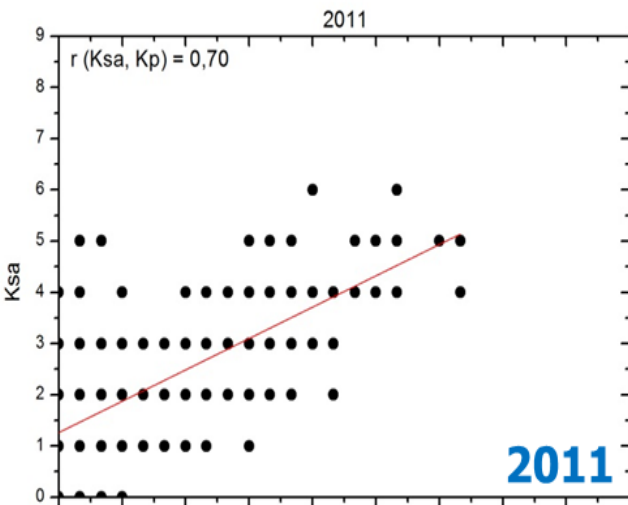
meses
J



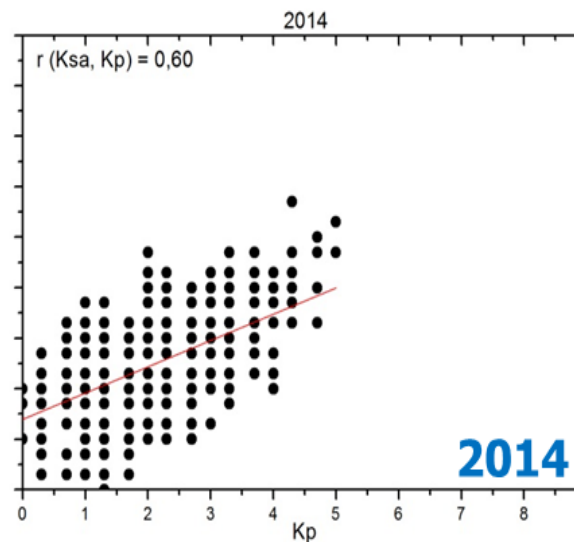
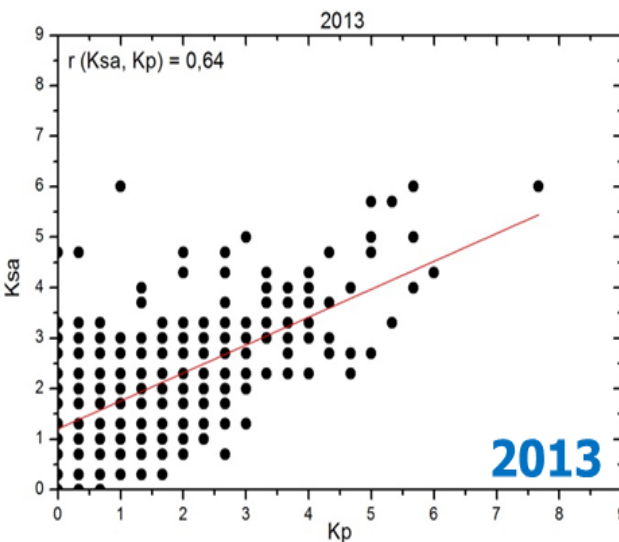
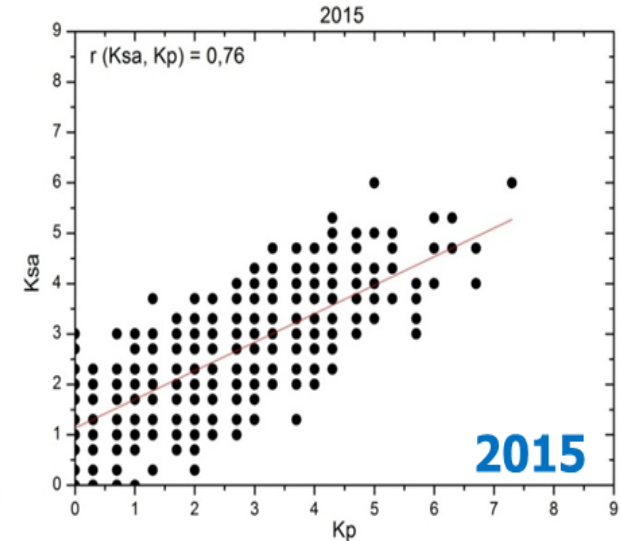
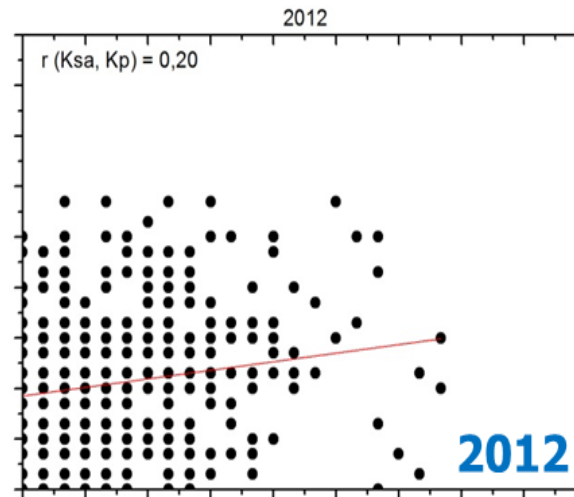
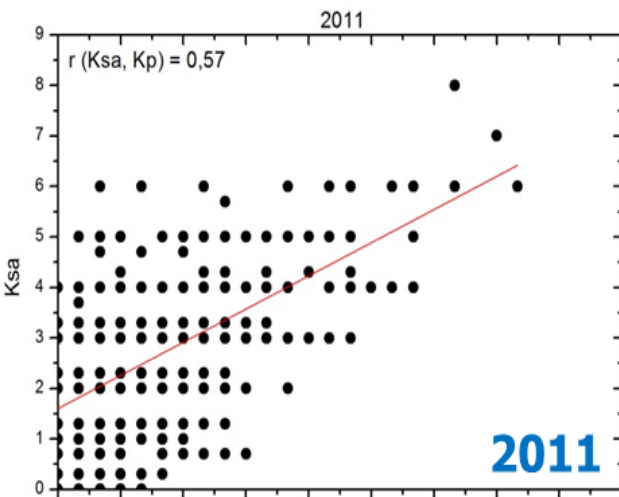
The South American K Index

www.inpe.br/spaceweather

2011 to 2015

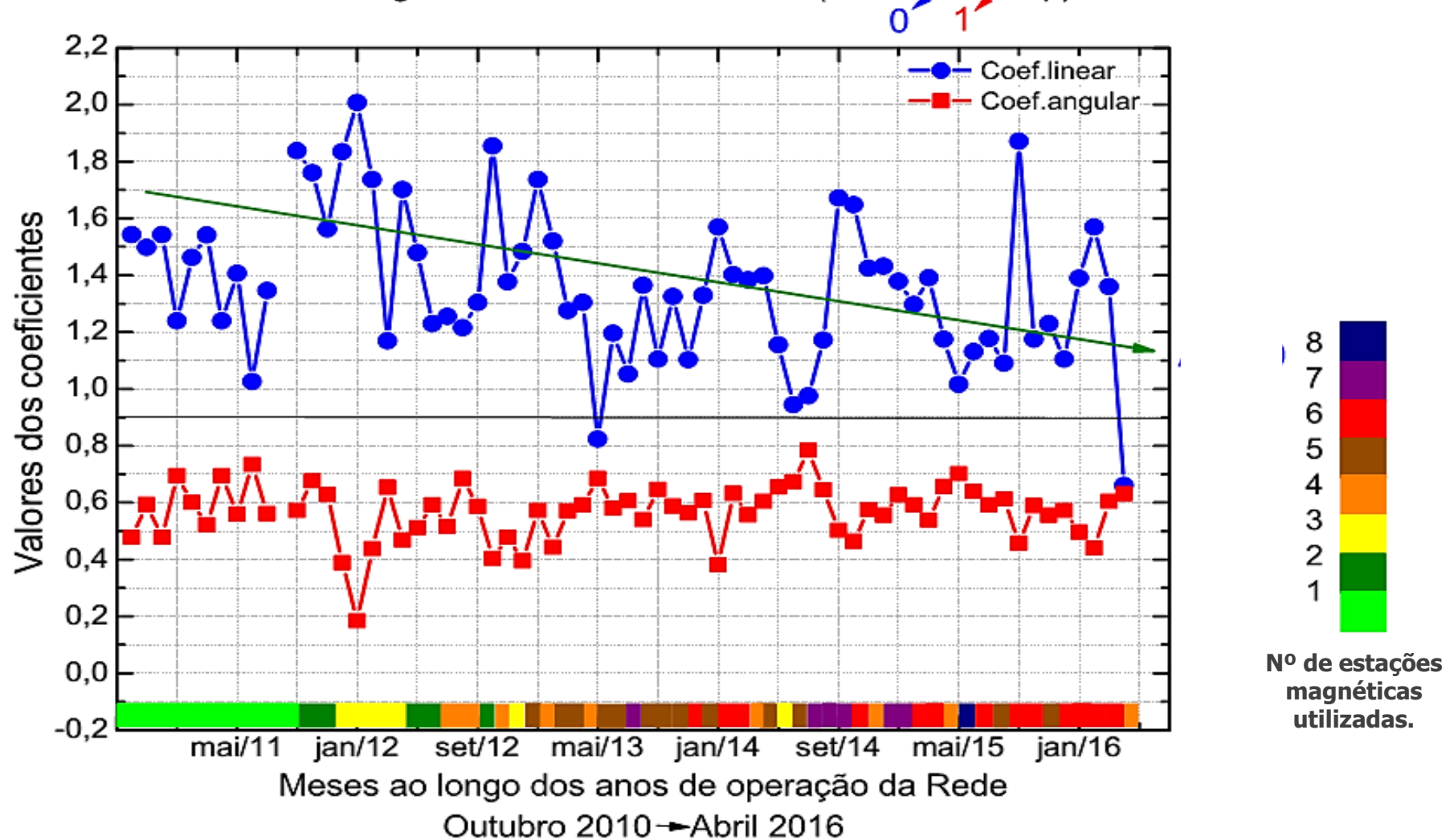


meses
E1



meses
E2

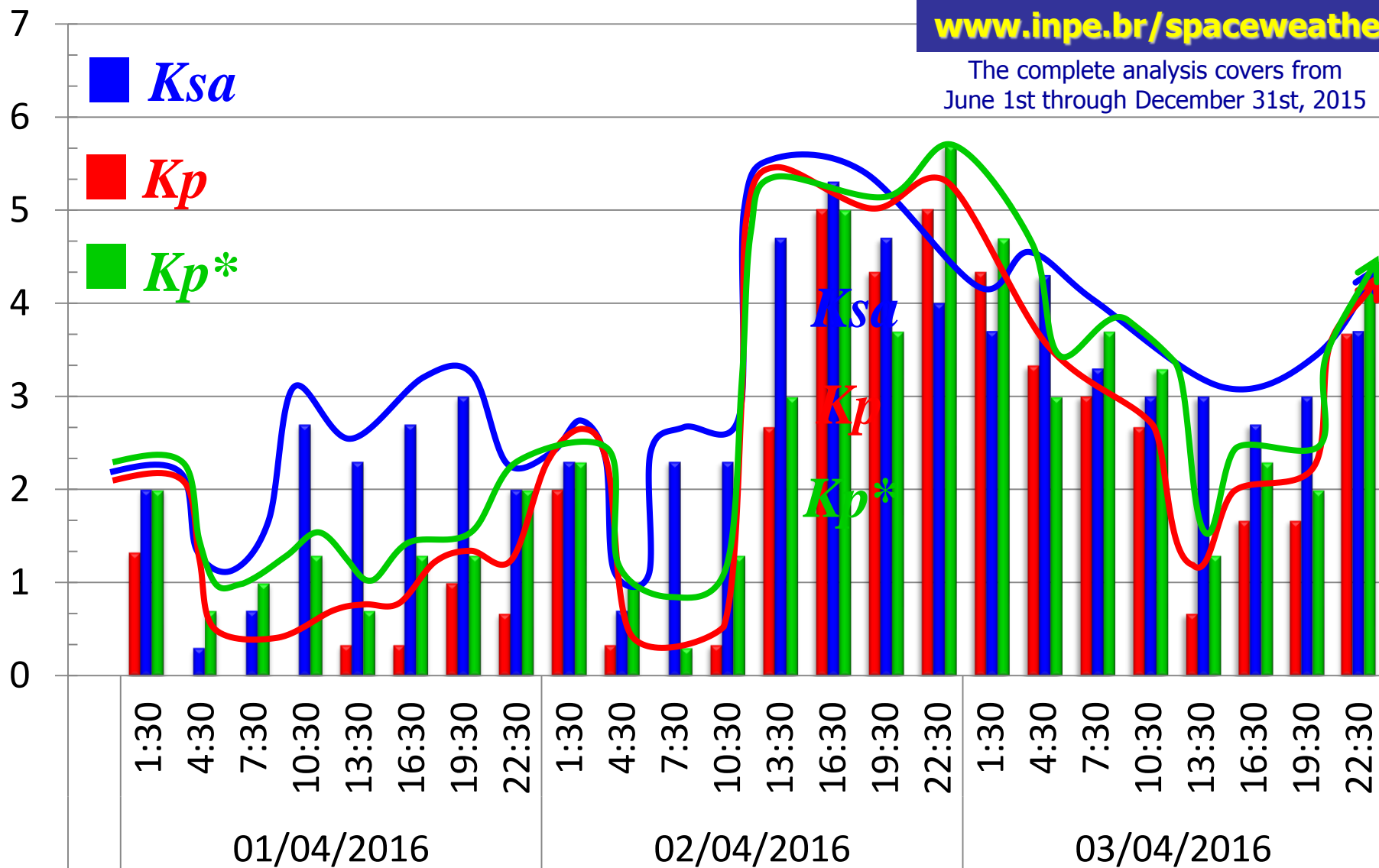
Distribuição dos coeficientes lineares e angulares para todos os dados magnéticos da Rede Embrace ($K_{sa} = A + B K_p$)



Validation Process

www.inpe.br/spaceweather

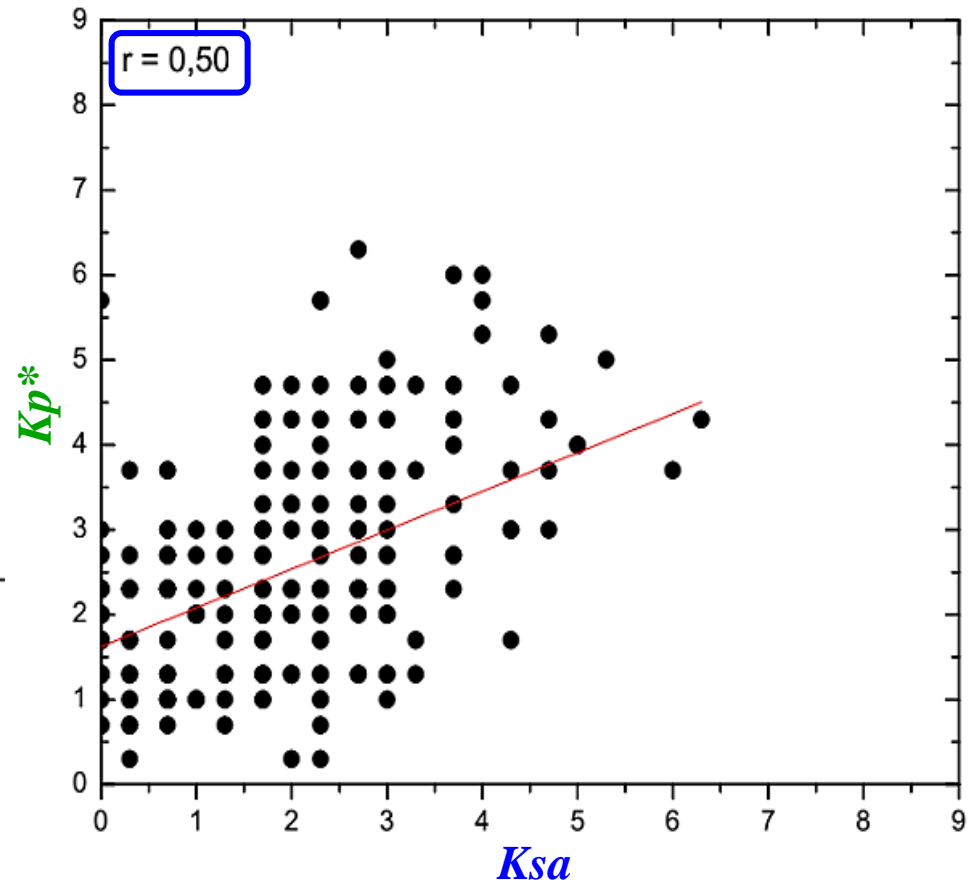
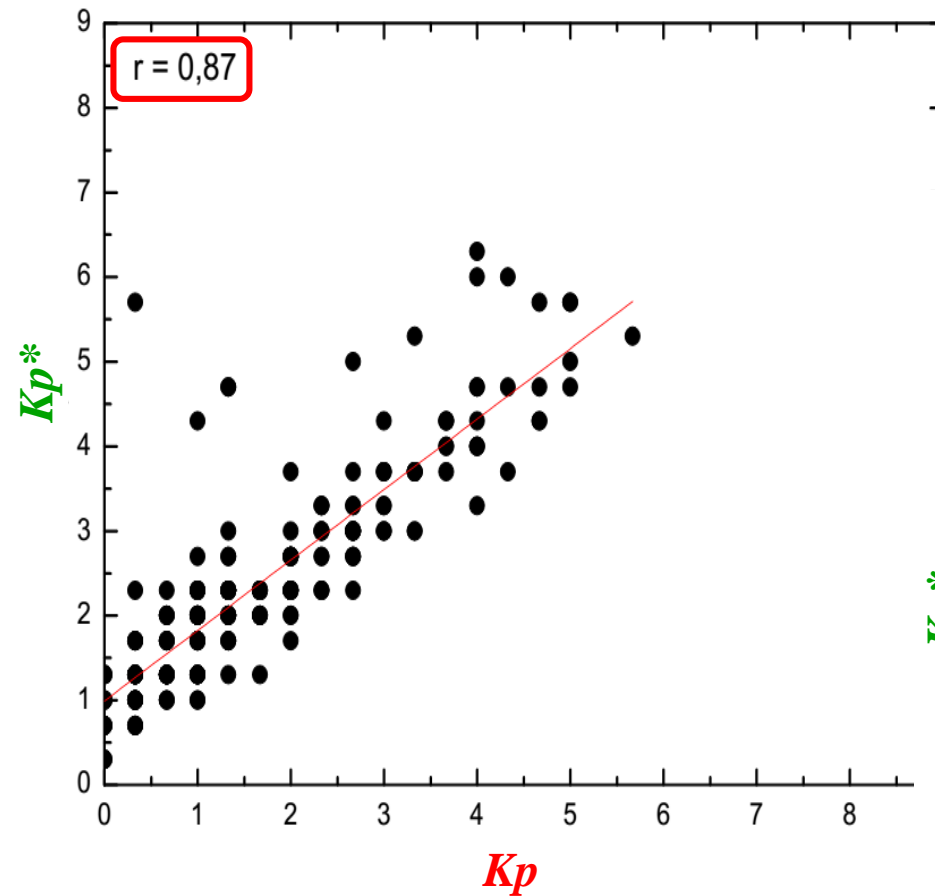
The complete analysis covers from
June 1st through December 31st, 2015



UNPUBLISHED MATERIAL – NO REPRODUCTION AUTHORIZED

www.inpe.br/spaceweather

The complete analysis covers from June 1st through December 31st, 2015
Once the index can only assume fixed values, there are several points plotted over each dot.



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<https://play.google.com/store/apps/details?id=br.inpe.climaespacial.mobile>

 Apps

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 Shop

< Games
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 Parent Guide
 Editors' Choice




Embrace Mobile

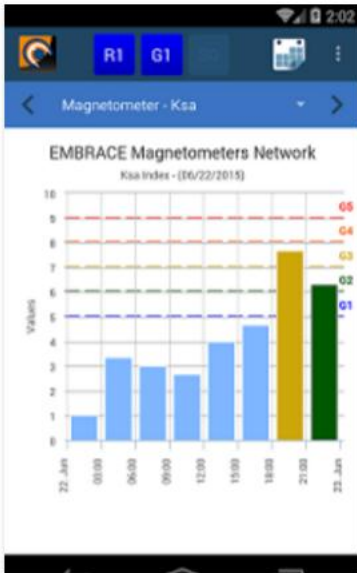
Brazilian Study and Monitoring of Space Weather Weather ★★★★★ 5

L

This app is compatible with all of your devices.

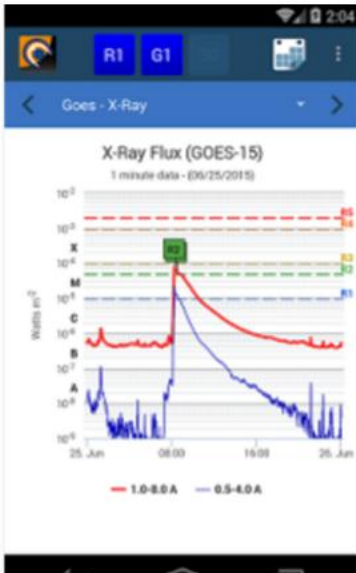
Installed





EMBRACE Magnetometers Network
Ksa Index - (16/22/2015)

Time	Value
22 Jun 01:00	1.0
05:00	3.5
09:00	3.0
13:00	2.5
17:00	4.0
21:00	5.5
22 Jun 01:00	6.5
05:00	7.5
09:00	8.5
13:00	9.5
17:00	10.5
21:00	11.5
22 Jun 01:00	12.5



X-Ray Flux (GOES-15)
1 minute data - (06/25/2015)

1.0-8.0 A 0.5-4.0 A



Bulletin

Magnetometer - Ksa

Goes - X-Ray

Bulletin

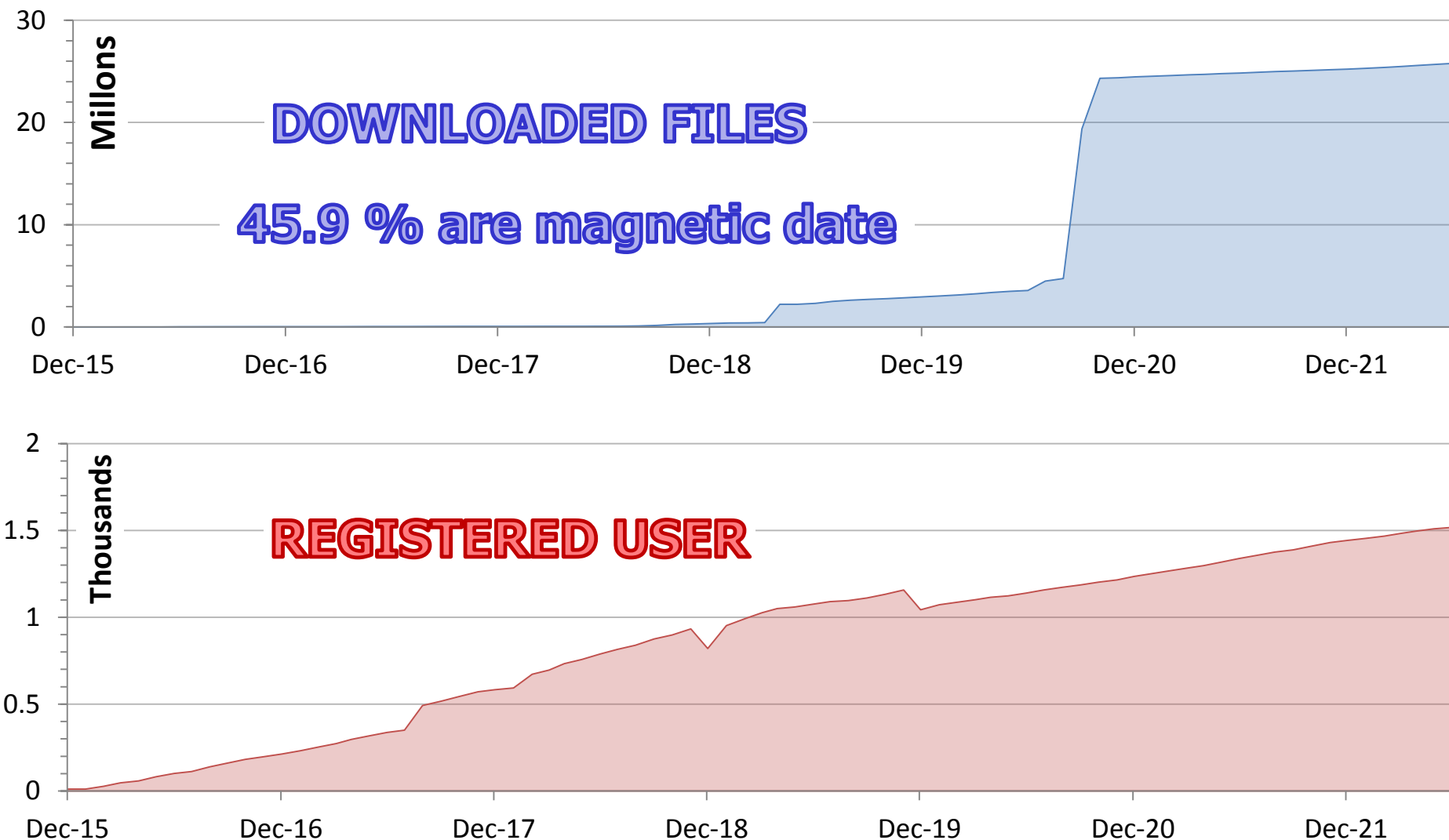
There are low solar activity. In accordance with the LASCO and STEREO experiments, at the moment this bulletin is being posted, there exist no CME Earth directed. The recurrent transequatorial coronal hole, CH 682, is due to be Earth directed on 12th-13th August. By now, and for the next 48 hours, both the

Where is the data center ?



Who process it ?





➔ Networks Description

- ➔ We have 9 magnetic stations providing quality data
- ➔ Another is to be installed this year and 3 others in the next year
- ➔ 4 other magnetic sensors are under calibration and 3 others are to be bought this December
- ➔ Graphs are available online **FREE** and data is coming online soon

➔ Scientific Results

- ➔ We have good magnetic real-time data (1-min resolution), that can detect sudden magnetic variation
- ➔ We achieve the first results of the seasonal variations of the magnetic measurements at three different latitudes in Brazil performed with the magnetic data collected by Embrace Magnetometer Network
- ➔ We have **new magnetic indices**: Ksa, Dst proxy and GIC proxy
- ➔ Due to the secular variation of the magnetic field, we decided by a **new approach** for converting the station K to the standardized station Ks. We make use of the monthly QDC instead of the 'correction' tables usually applied
- ➔ These results for the Dst Proxy revealed a variation of the index compatible with the Dst, specially during large magnetic storms ($R^2 > 0.7$). However, during 'quiet' conditions a large variability is observed, which drastically reduced the correlations between the two indices ($R^2 < 0.4$).
- ➔ These differences seem to affect the Ksa index during 'low' magnetic activity too. There is a pretty good agreement between the Kp and the Ksa during the major magnetic storm analyzed. However, larger fluctuations are observed during the recovery phase of the magnetic storms and/or during 'quiet' magnetic activity.
- ➔ We are not sure although if these differences are due to the technique itself or to the poor Kp sampling in the American sector. Therefore, this topic needs to be further investigated.

➔ BOTTOM-LINE

- ➔ All the information is **free of charge and open to the whole world**.
- ➔ All that we ask is to put the proper credit in the acknowledgement of the papers and presentations.



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Embrace Program

(Network manager)



Universidade do Vale do Paraíba

(Network partner)



Universidad Nacional de La Plata

(Network partner)



Observatório Nacional

(Network partner)



Universidad Nacional de Tucumán

(Network partner)



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