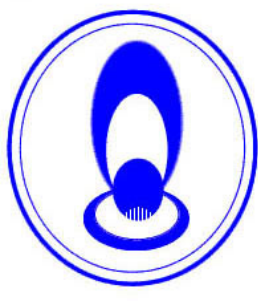
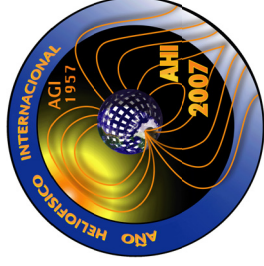


GEOMAGNETISMO Y EL PROYECTO AIRES: “ARGENTINA IONOSPHERIC RADAR EXPERIMENTAL STATION”

JULIO CESAR GIANIBELLI

**DEPARTAMENTO DE GEOMAGNETISMO Y AERONOMIA
OBSERVATORIO GEOFISICO DE TRELEW
FACULTAD DE CIENCIAS ASTRONOMICAS Y
GEOFISICAS – UNIVERSIDAD NACIONAL DE LA PLATA**

jcg@fcaglp.unlp.edu.ar

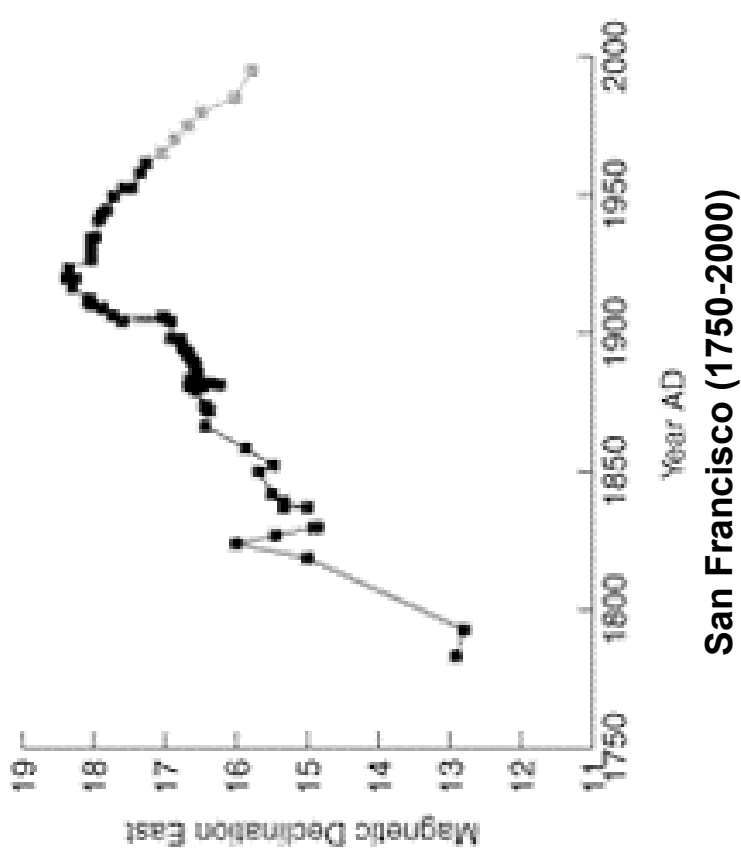
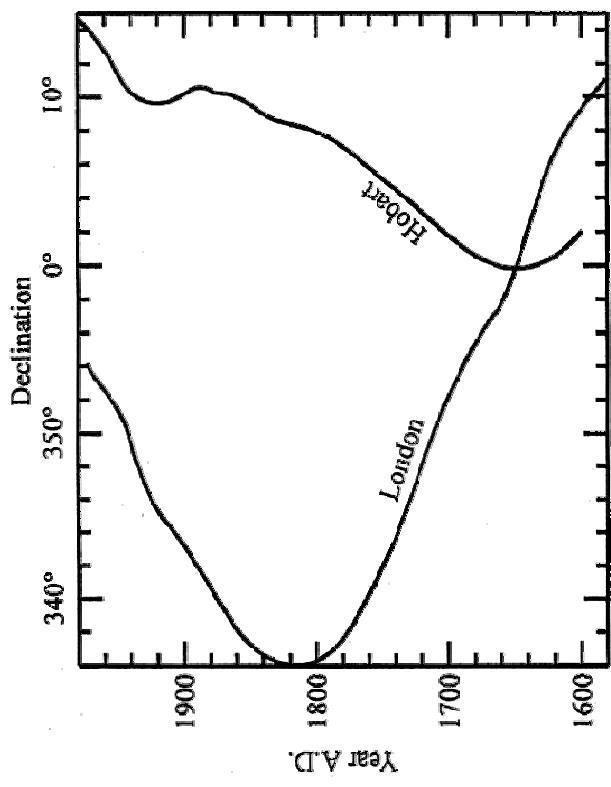




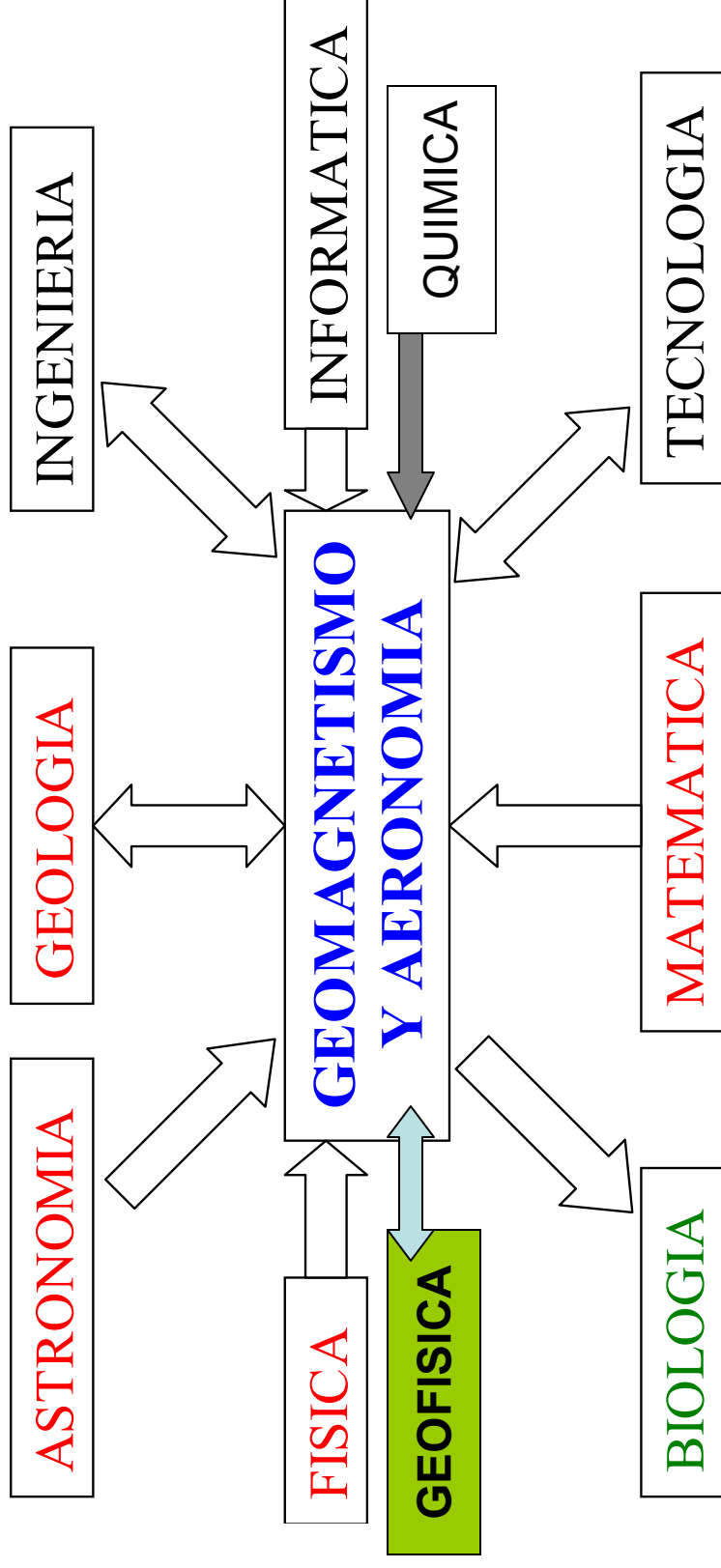
**-COMPAS MAGNETICO DINASTIA HAN
200 AÑOS ANTES DE CRISTO**

-VARIACION DE D

-CAMBIO DE D EN SAN FRANCISCO

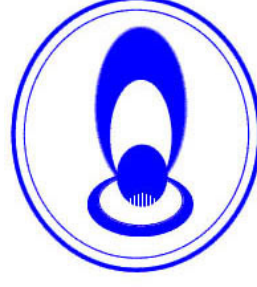
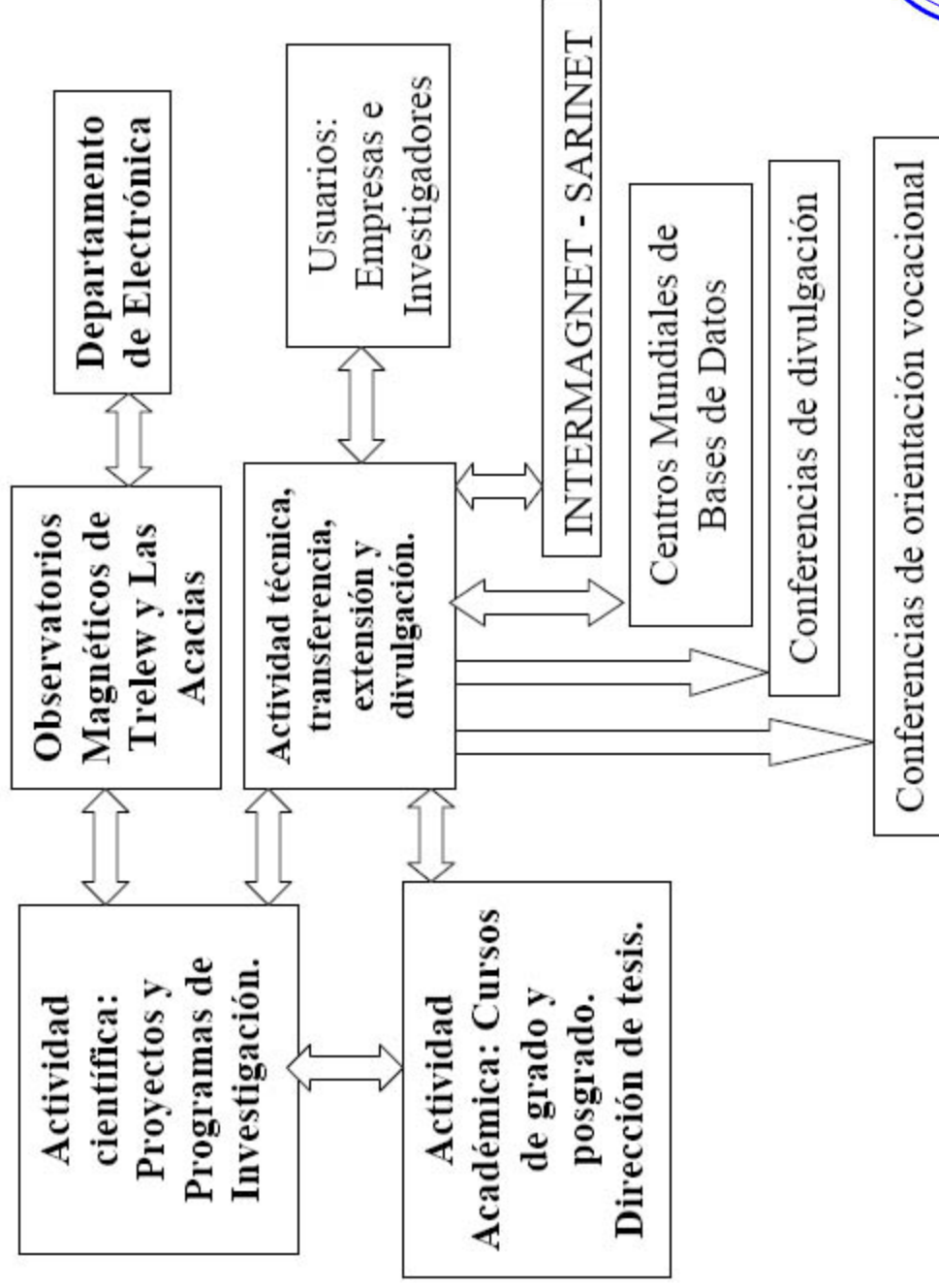


EL GEOMAGNETISMO Y LA AERONOMIA Y SU RELACION CON OTRAS DISCIPLINAS DE LA CIENCIA

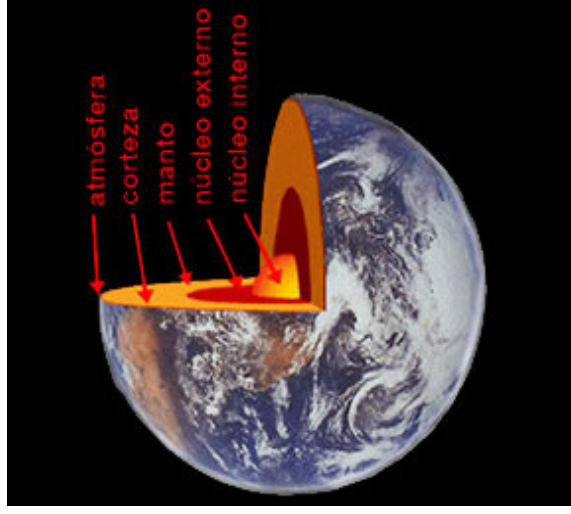
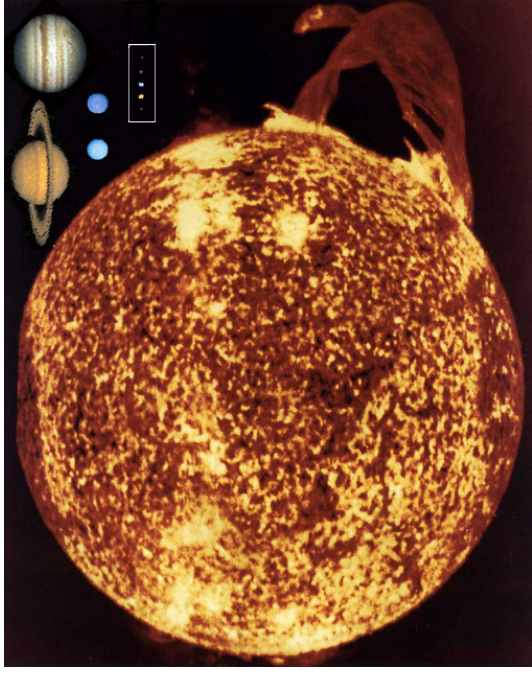
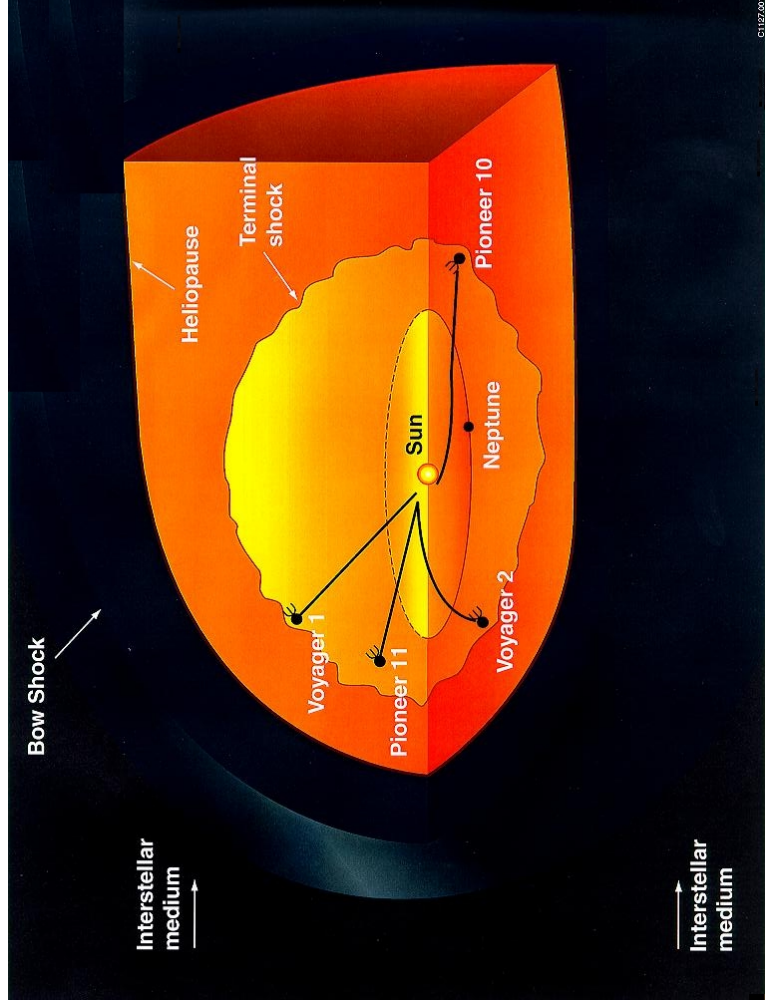




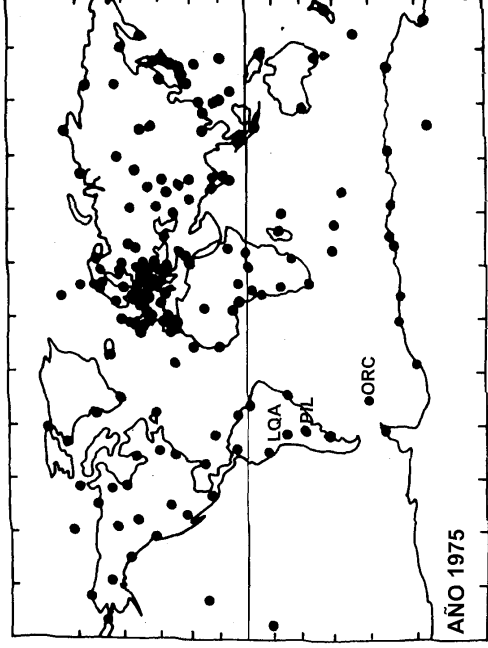
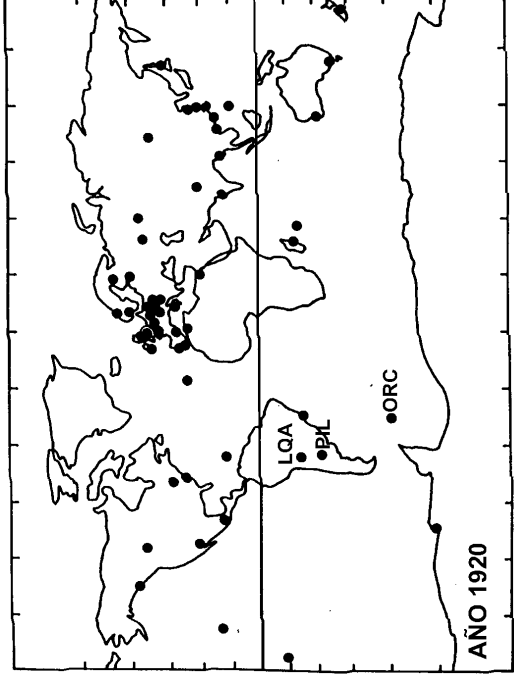
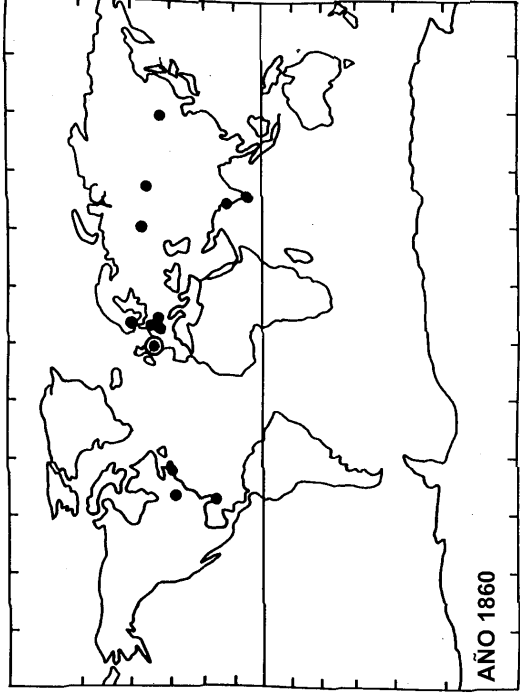
DEPARTAMENTO DE GEOMAGNETISMO Y AERONOMIA



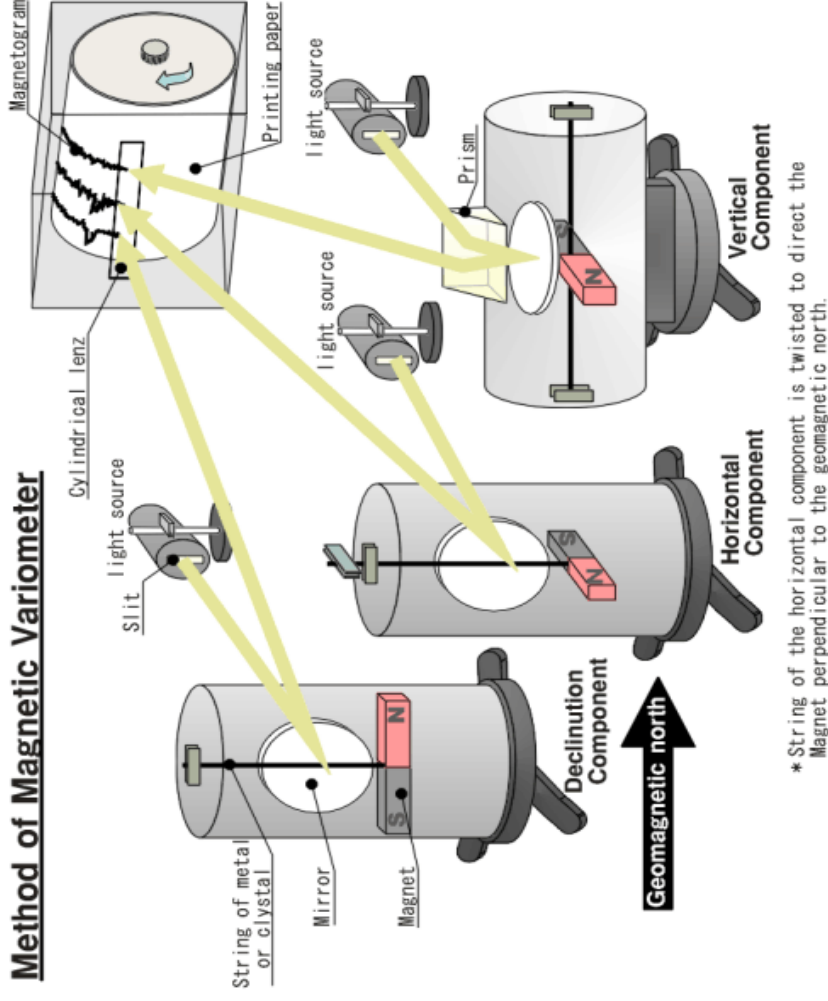
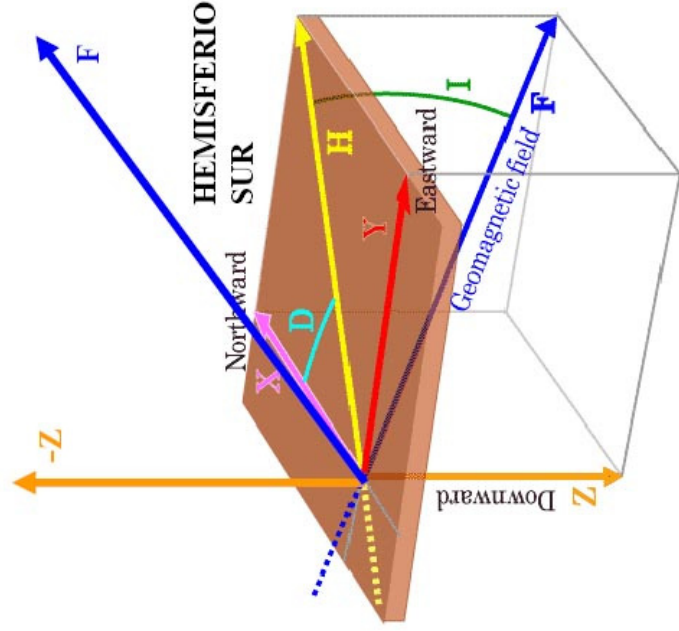
LA ACTIVIDAD DESARROLLADA POR EL HOMBRE SE ENCUENTRA RELACIONADA CON LOS CAMBIOS DE DIFERENTES PERIODOS QUE POSEE EL SISTEMA DONDE HABITA QUE SE DENOMINA **GEOSISTEMA**. PERTENECE AL SISTEMA SOLAR Y ESTE A SU VEZ ESTA CONTENIDO EN OTRO DE MAYOR ENVERGADURA LLAMADO **HELIOSFERA**



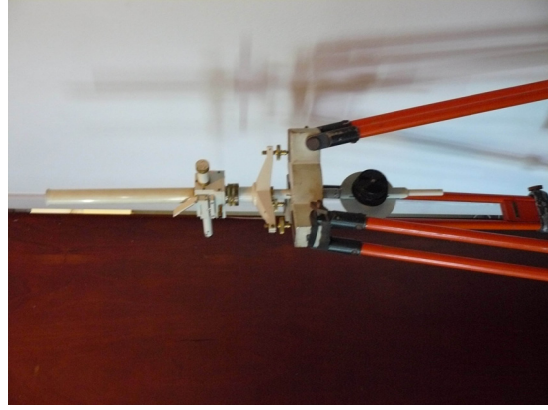
EVOLUCION TEMPORAL DE LOS OBSERVATORIOS MAGNETICOS

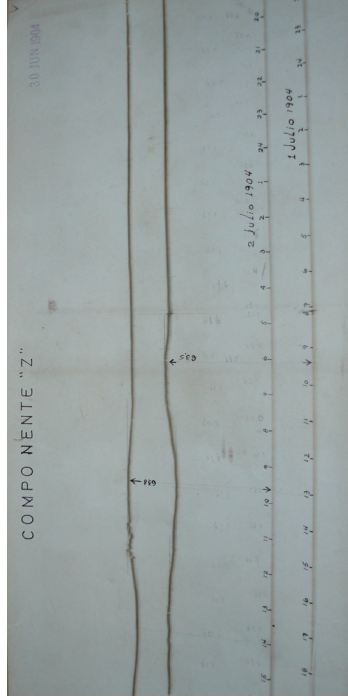
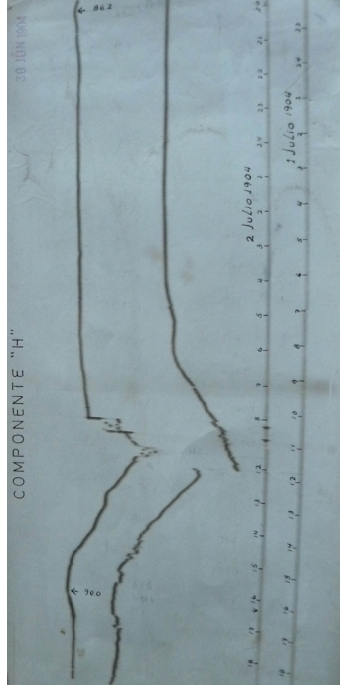
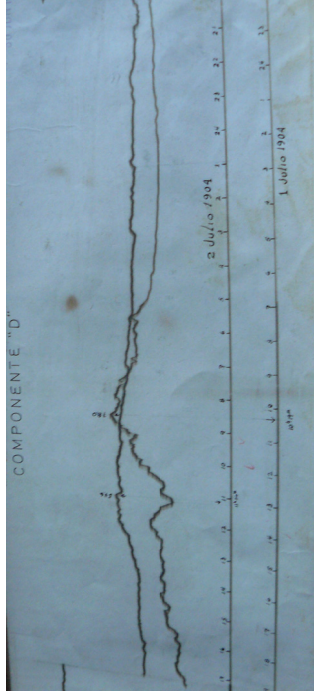


Method of Magnetic Variometer



* String of the horizontal component is twisted to direct the Magnet perpendicular to the geomagnetic north.





PRIMEROS REGISTROS DE PILAR 2 DE JULIO 1904

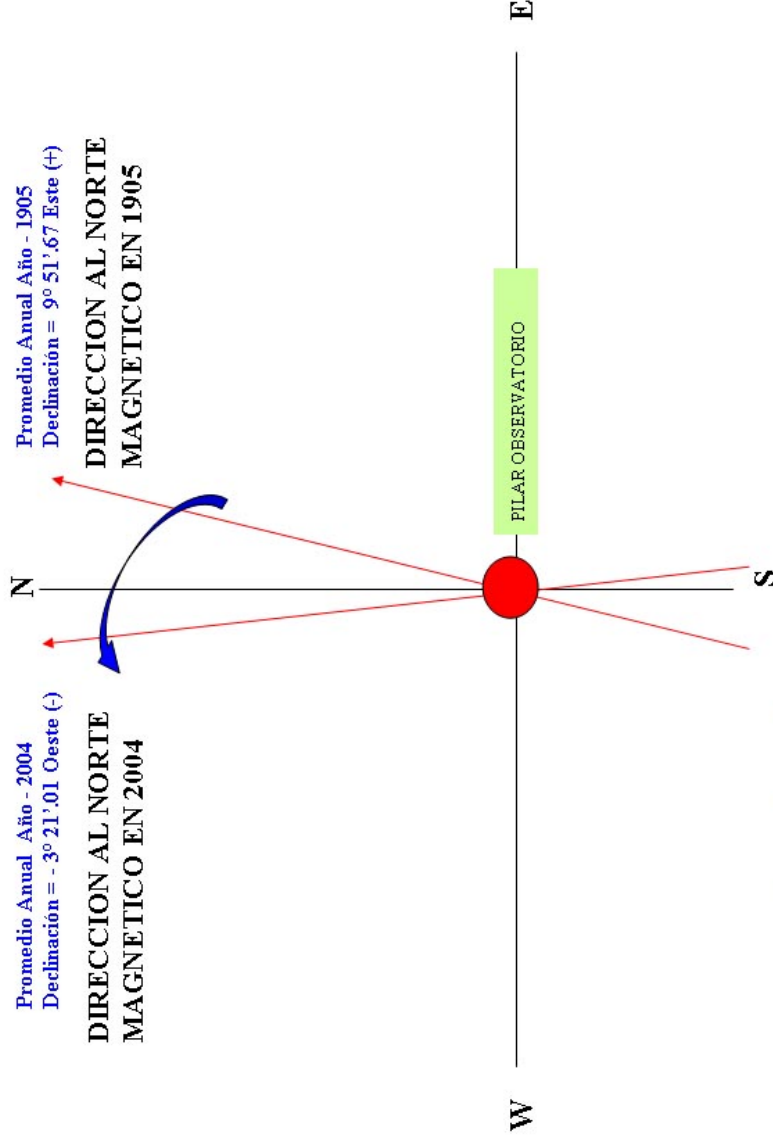
OBSEVATORIO MAGNETICO PILAR "DECLINACION MAGNETICA" VARIACION SECULAR
PERIODO DE REGISTRO 100 años (1905 a 2004) Eje de referencia Meridiano Geográfico
Pilar: Latitud 31° 40' S; Longitud 63° 53' Oeste = 4 Hs 15min 32seg Oeste de Greenwich
Variación registrada el el periodo establecido= 13° 12' 8 de Este a Oeste

Promedio Anual Año - 2004
Declinación = - 3° 21' 01 Oeste (-)

DIRECCION AL NORTE
MAGNETICO EN 2004

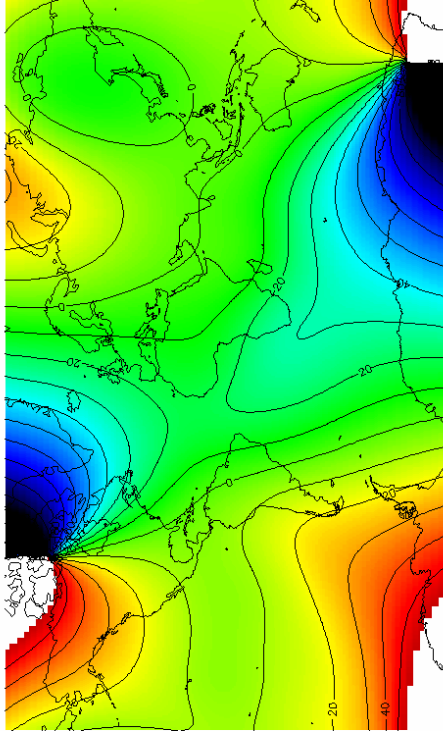
Promedio Anual Año - 1905
Declinación = 9° 51' 67 Este (+)

DIRECCION AL NORTE
MAGNETICO EN 1905

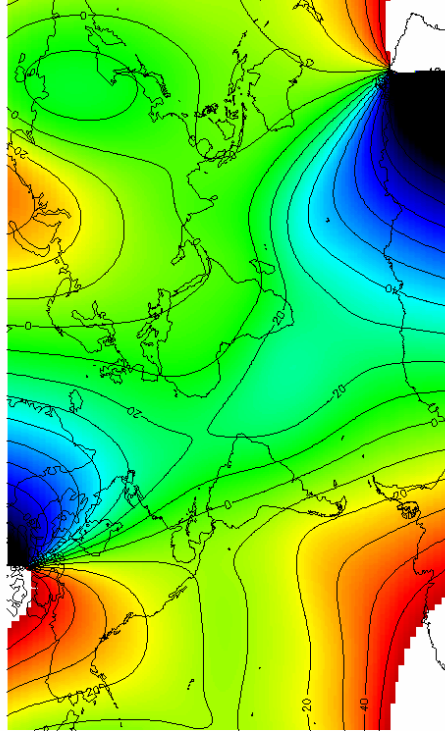


La Declinación Magnética cruzó el meridiano de "Este a Oeste" entre los meses de Abril y Mayo de 1982 y continúa declinando hacia el Oeste

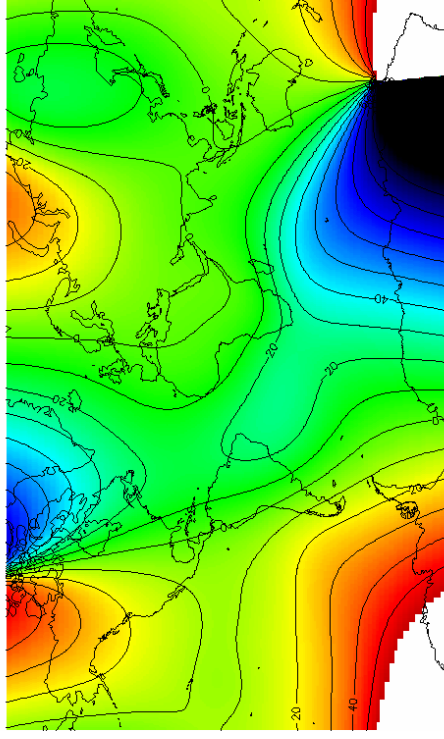
D - 1900



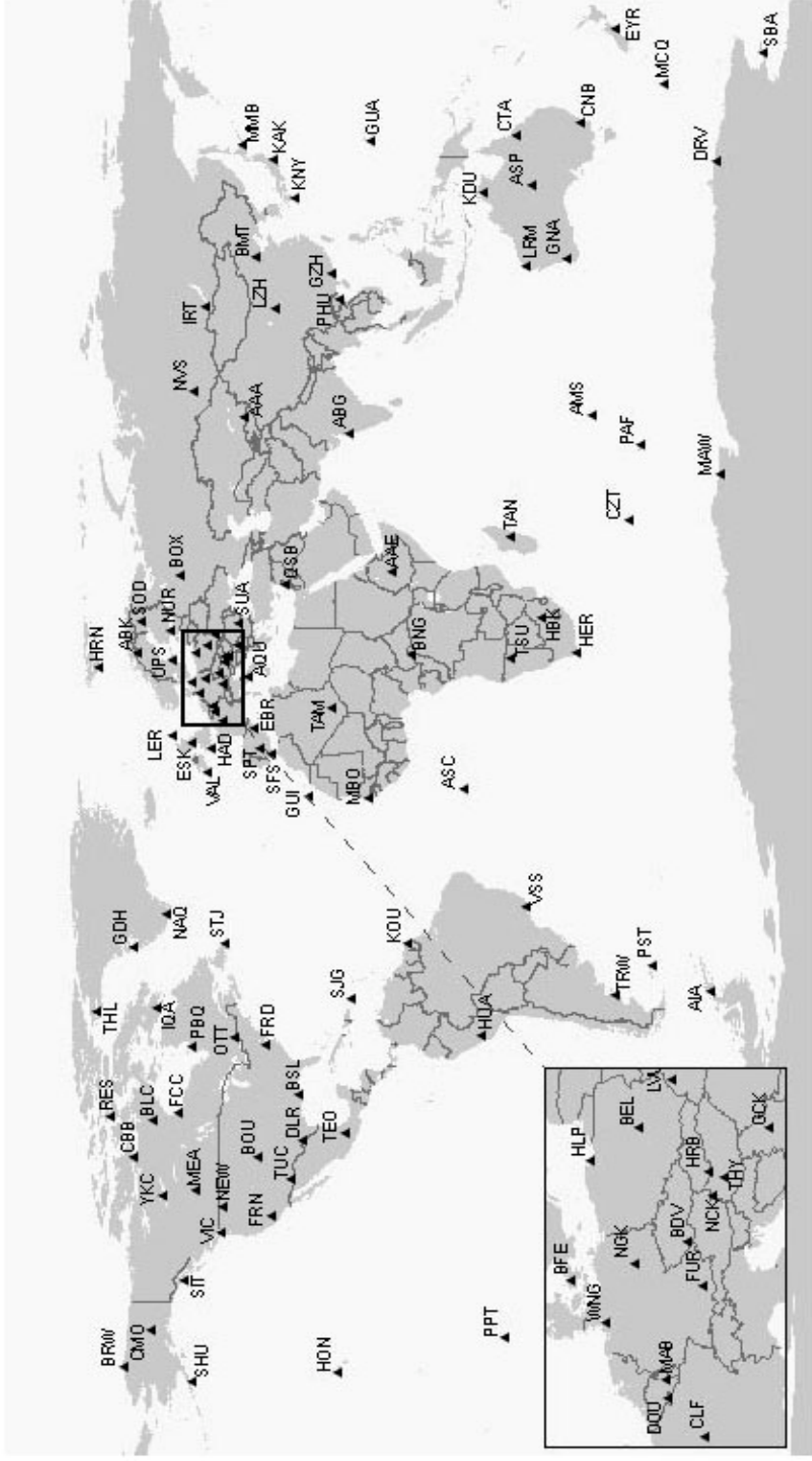
D - 1950



D - 2000

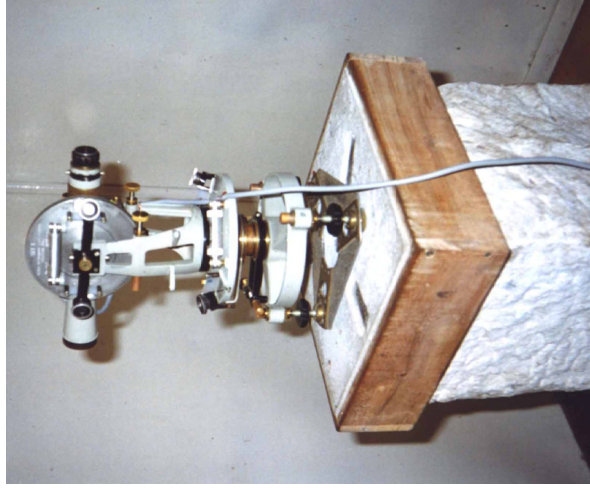
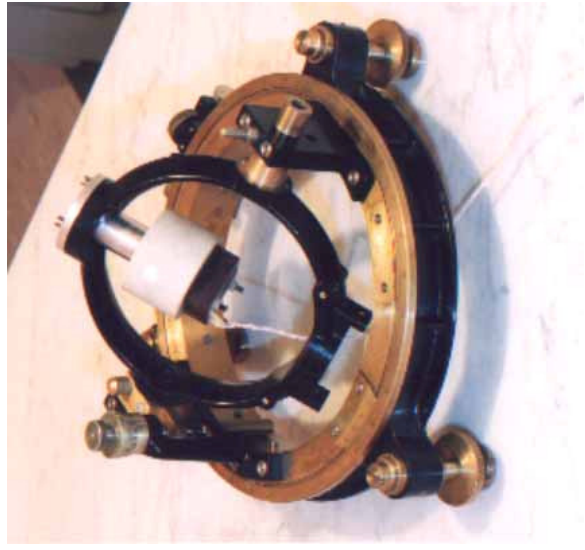


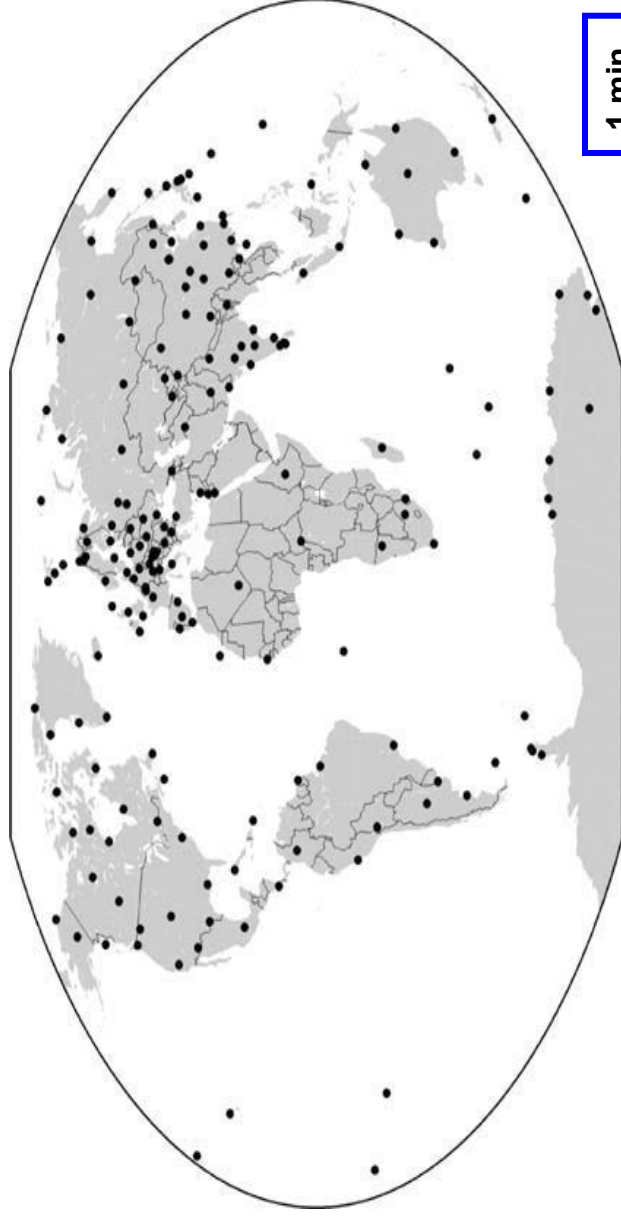
INTERMAGNET



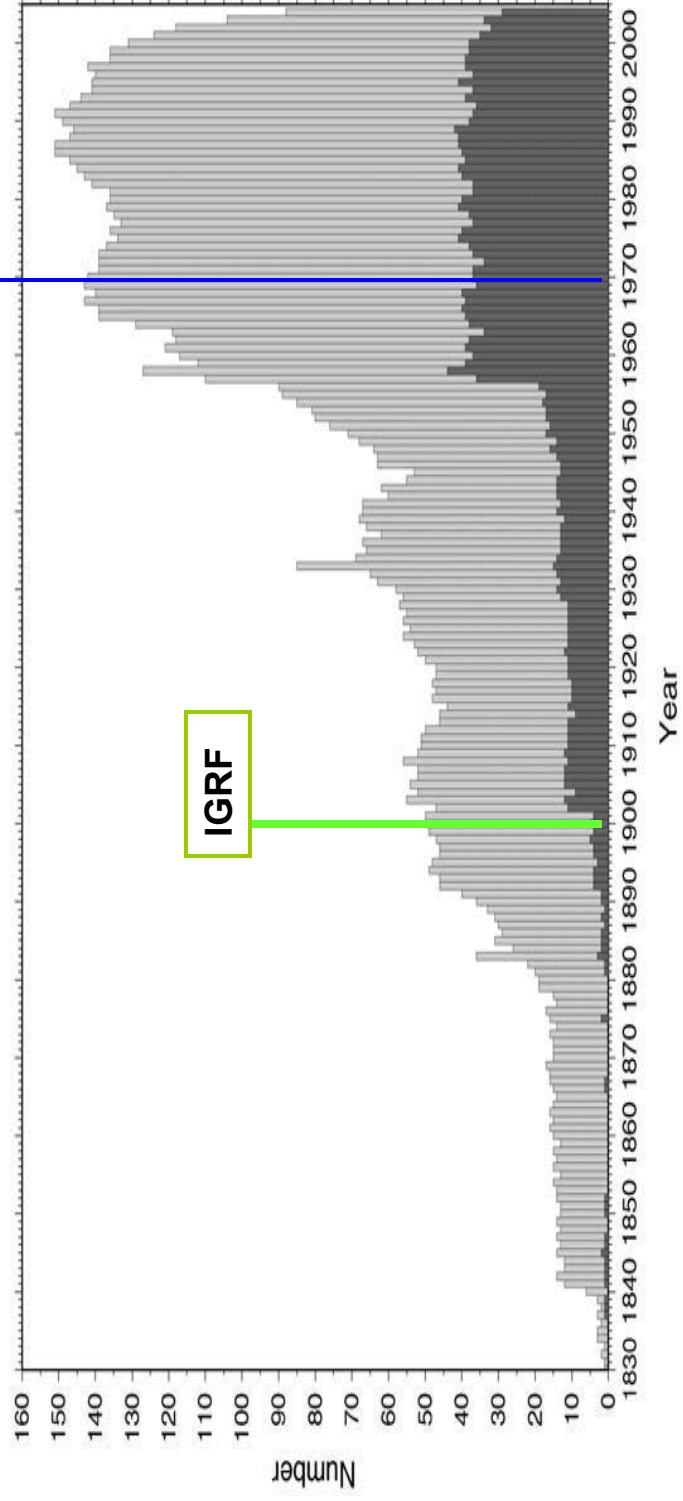
OBSERVATORIOS EN OPERACION 2007

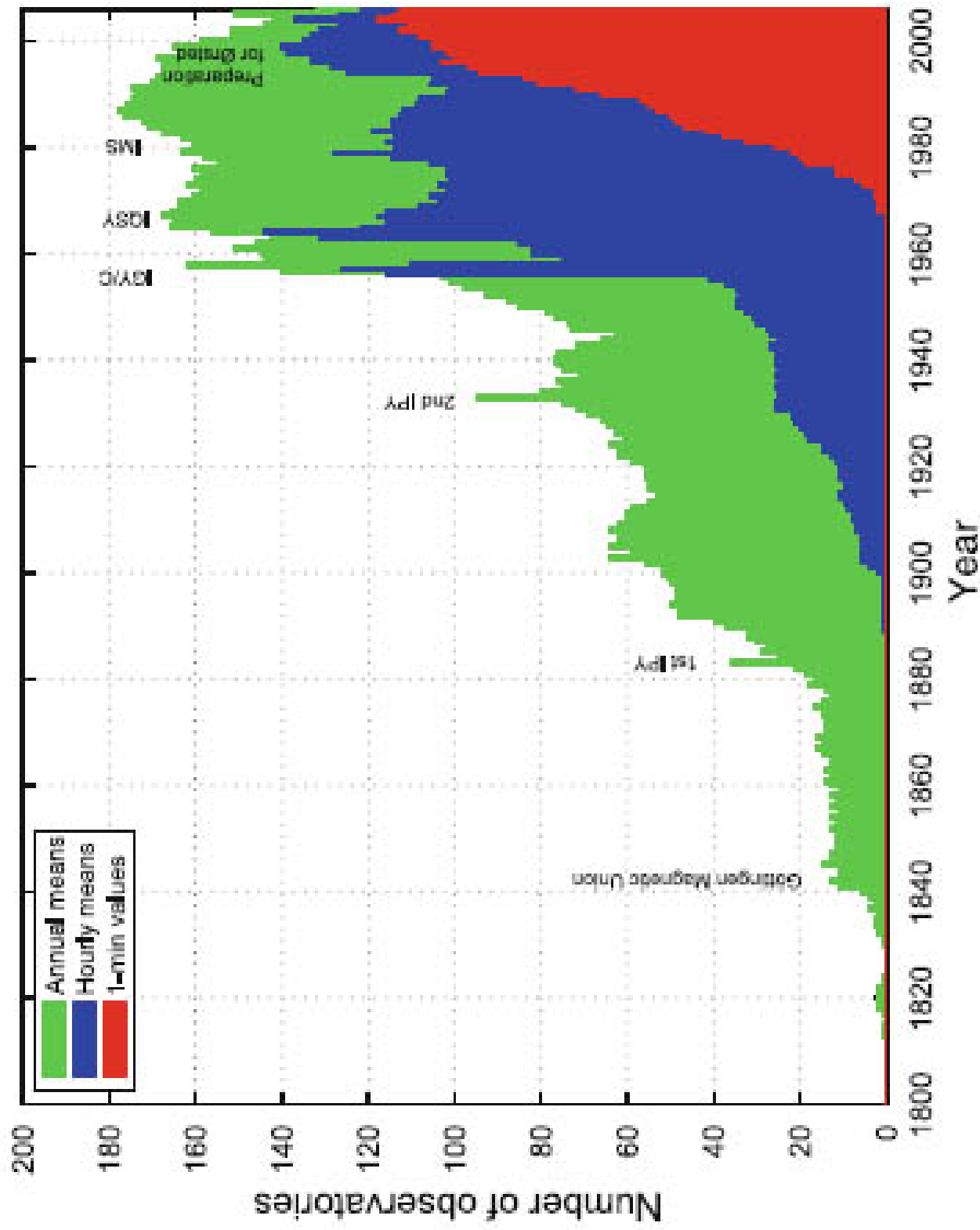
TRELEW





1 min.

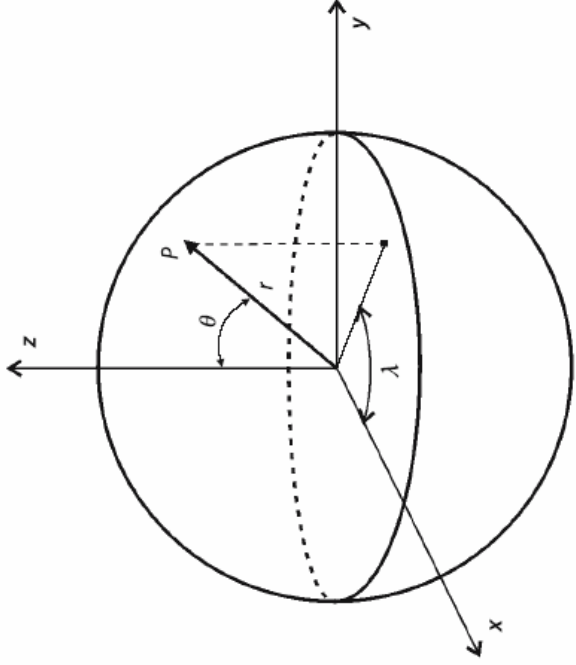




LAS COMPONENTES DEL CAMPO: e: fuentes externas, i: fuentes internas

$$\Delta V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0 \quad V = a \sum_{n=1}^{\infty} \left[\left(\frac{r}{a} \right)^n T_n^e + \left(\frac{a}{r} \right)^{n+1} T_n^i \right] \quad T_n = \sum_{m=0}^n (g_n^m \cos m\lambda + h_n^m \sin m\lambda) P_n^m(\theta)$$

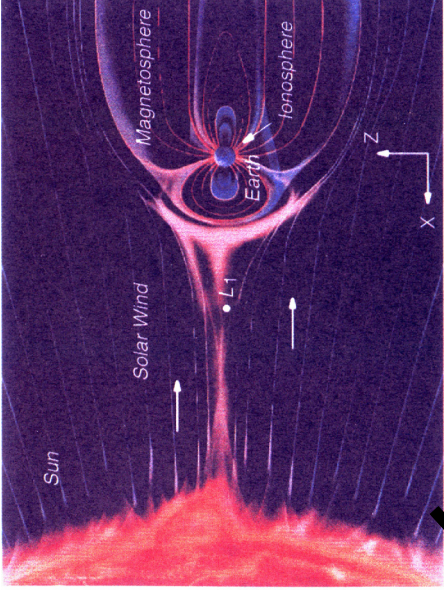
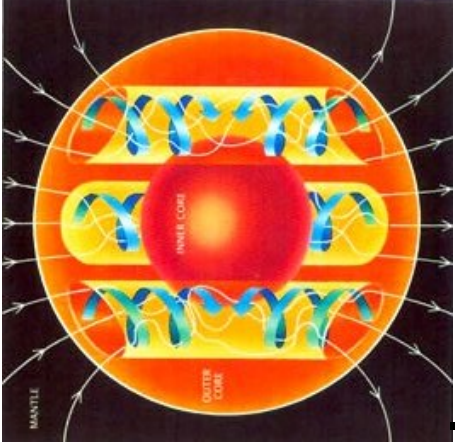
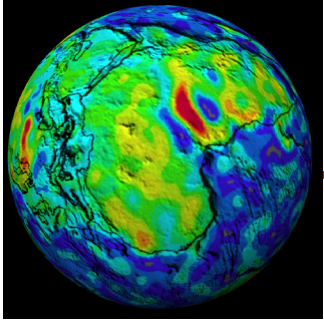
$$X = \frac{\partial V}{r \partial \theta} = \frac{a}{r} \sum_{n=1}^{\infty} \sum_{m=0}^n \frac{dP_n^m}{d\theta} \left[\left\{ g_n^m \left(\frac{r}{a} \right)^n + g_n^{mi} \left(\frac{a}{r} \right)^{n+1} \right\} \cos m\lambda + \left\{ h_n^m \left(\frac{r}{a} \right)^n + h_n^{mi} \left(\frac{a}{r} \right)^{n+1} \right\} \sin m\lambda \right]$$



$$Y = \frac{-\partial V}{r \sin \theta \partial \lambda} = \frac{a}{r \sin \theta} \sum_{n=1}^{\infty} \sum_{m=0}^n P_n^m \left[m \left\{ g_n^m \left(\frac{r}{a} \right)^n + g_n^{mi} \left(\frac{a}{r} \right)^{n+1} \right\} \sin m\lambda - m \left\{ h_n^m \left(\frac{r}{a} \right)^n + h_n^{mi} \left(\frac{a}{r} \right)^{n+1} \right\} \cos m\lambda \right]$$

$$Z = \frac{\partial V}{\partial r} = \sum_{n=1}^{\infty} \sum_{m=0}^n P_n^m \left[\left\{ n g_n^m \left(\frac{r}{a} \right)^{n-1} - (n+1) g_n^{mi} \left(\frac{a}{r} \right)^{n+2} \right\} \cos m\lambda + \left\{ n h_n^m \left(\frac{r}{a} \right)^{n-1} - (n+1) h_n^{mi} \left(\frac{a}{r} \right)^{n+2} \right\} \sin m\lambda \right]$$

PORCENTAJES



**100%
CAMPO OBSERVADO
EN "P"
 $E(\lambda, \phi, r, t)$**

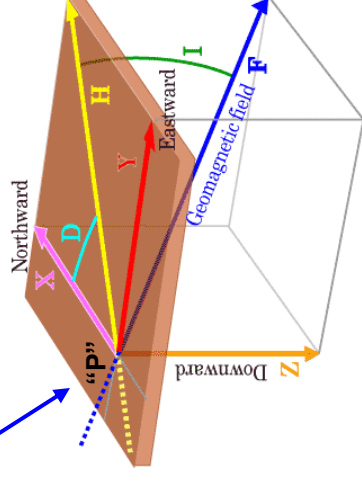
**95%
ORIGEN INTERNO
FUENTES: EN EL
NUCLEO EXTERNO
Y CORTEZA**

**85% ES DIPOLAR
13% NO DIPOLAR
2% ES CORTICAL**

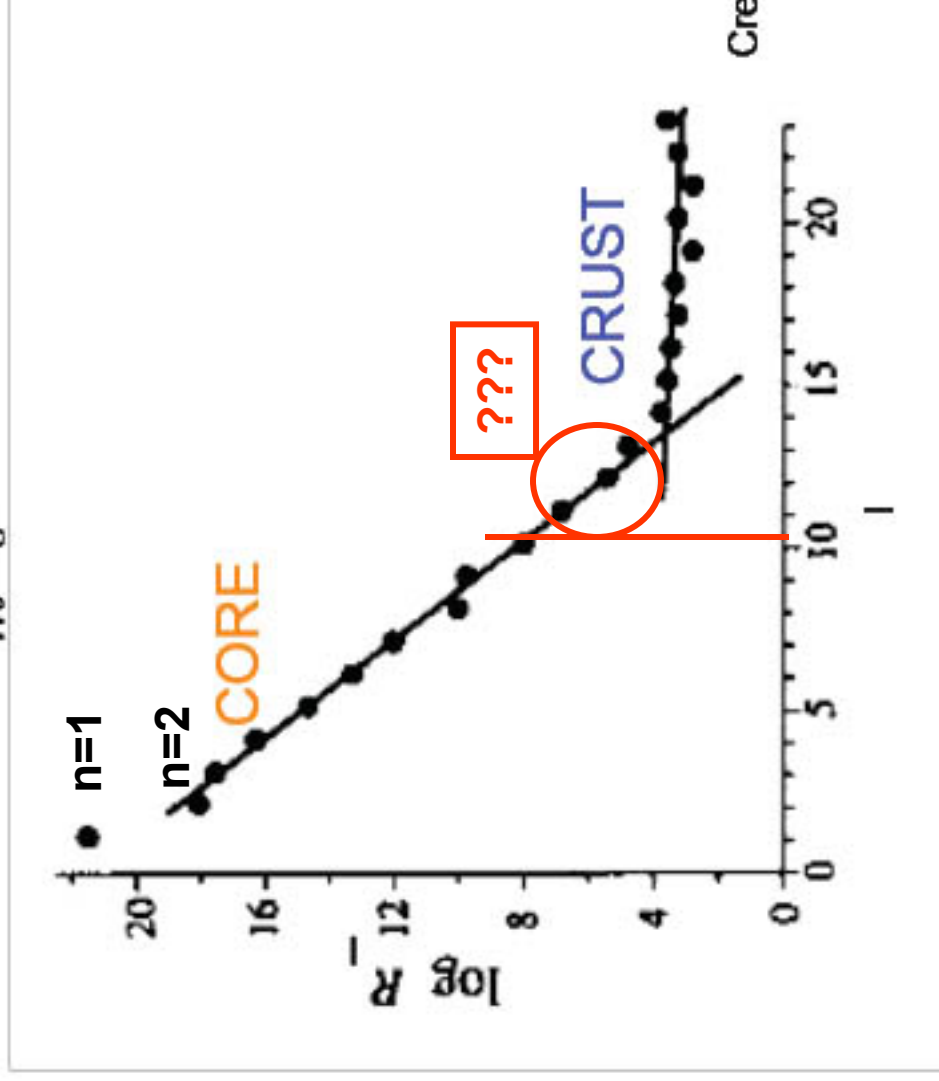
**4.97%
ORIGEN EXTERNO
FUENTES: EN LA CAVIDAD
MAGNETOSFERICA
E IONOSFERA**

**VARIACION DIURNA: 1-10%
TORMENTAS: 99-90%**

**0.03%
INDUCCION DE
LAS FUENTES DE ORIGEN
EXTERNO
SOBRE LA HIDROSFERA
Y TIERRA SOLIDA**

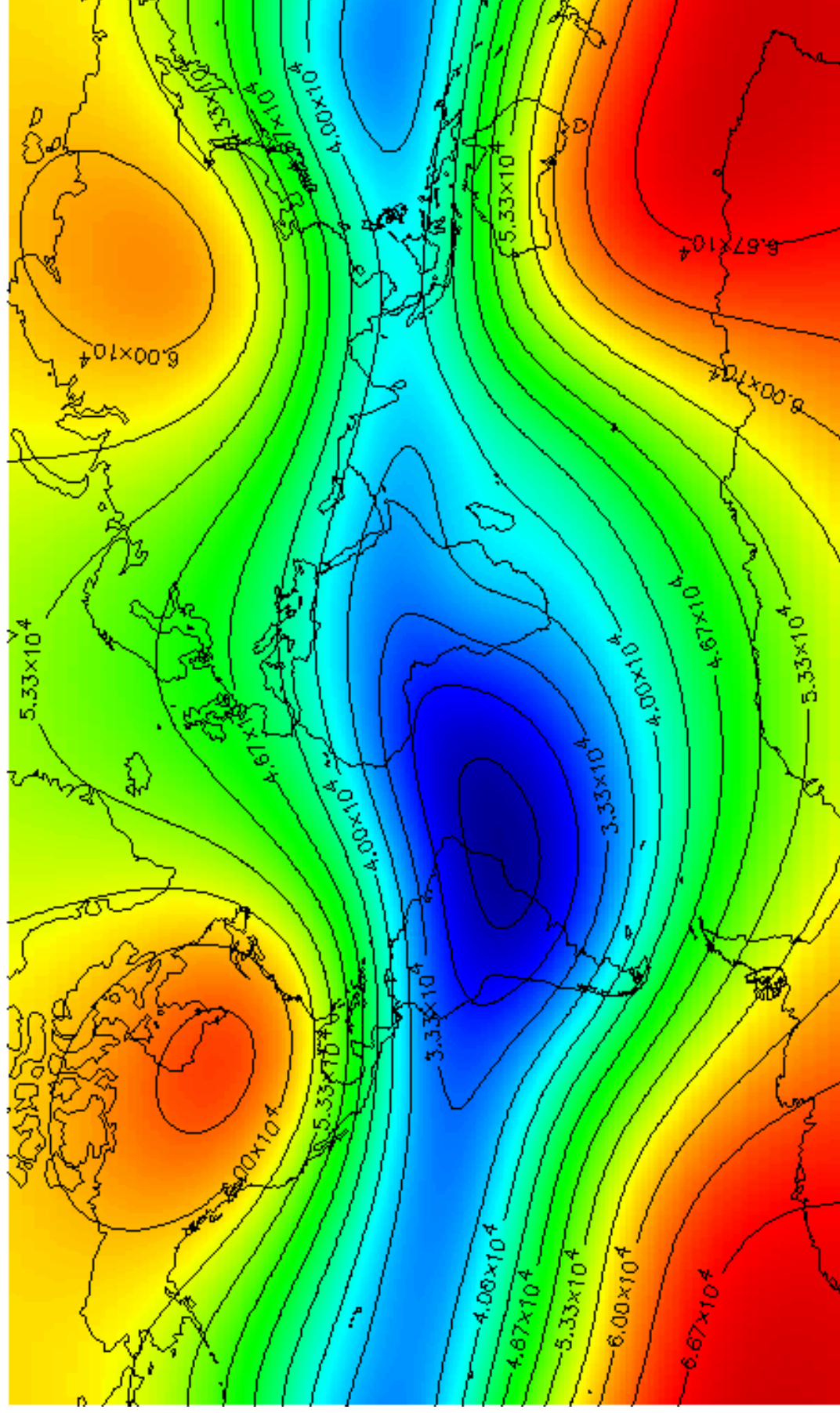


$$R_l = (l + 1) \left(\frac{a}{r} \right)^{2l+4} \sum_{m=0}^l [(g_l^m)^2 + (h_l^m)^2]^{\frac{1}{2}}$$

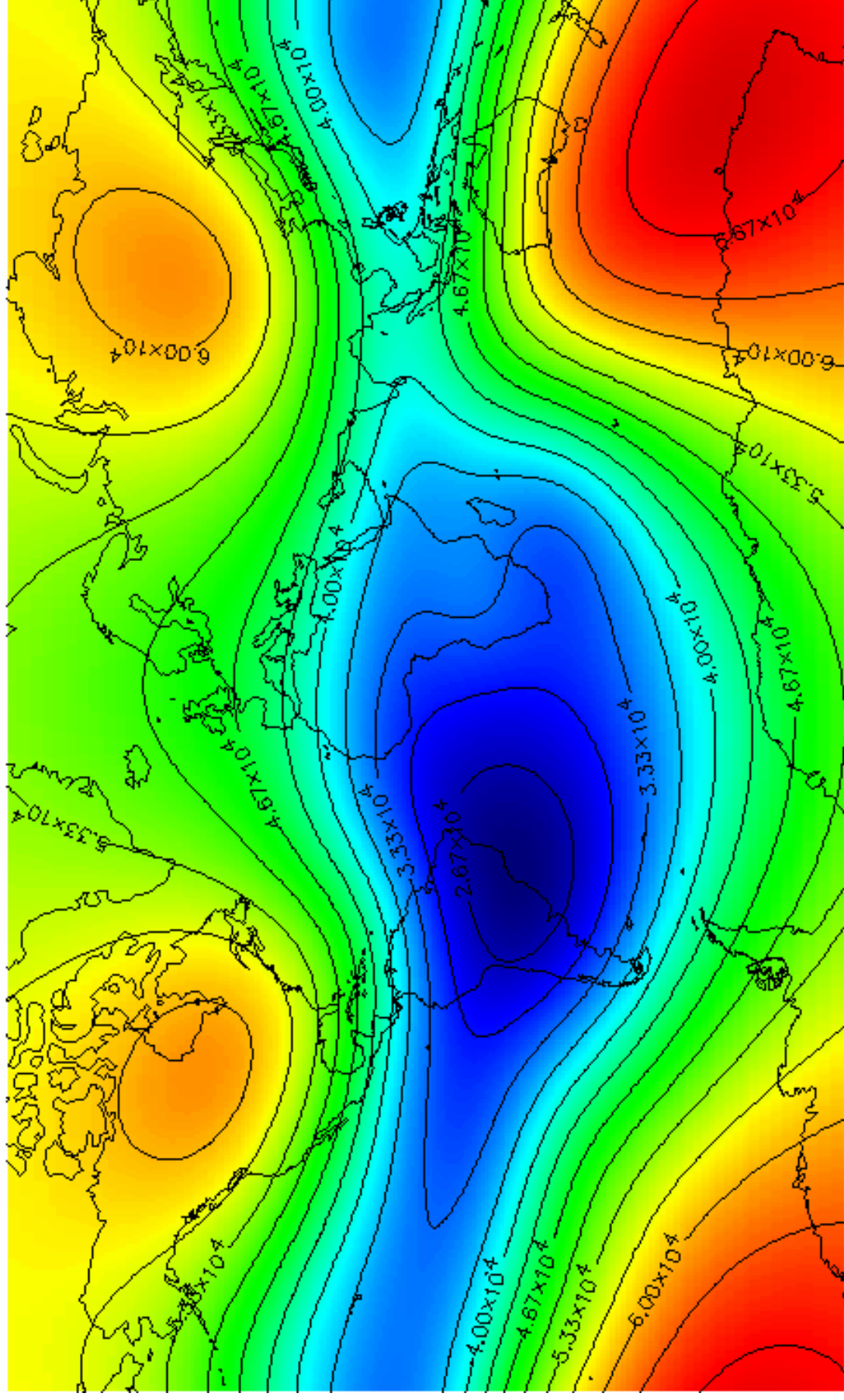


Credit: Blakely, 1995

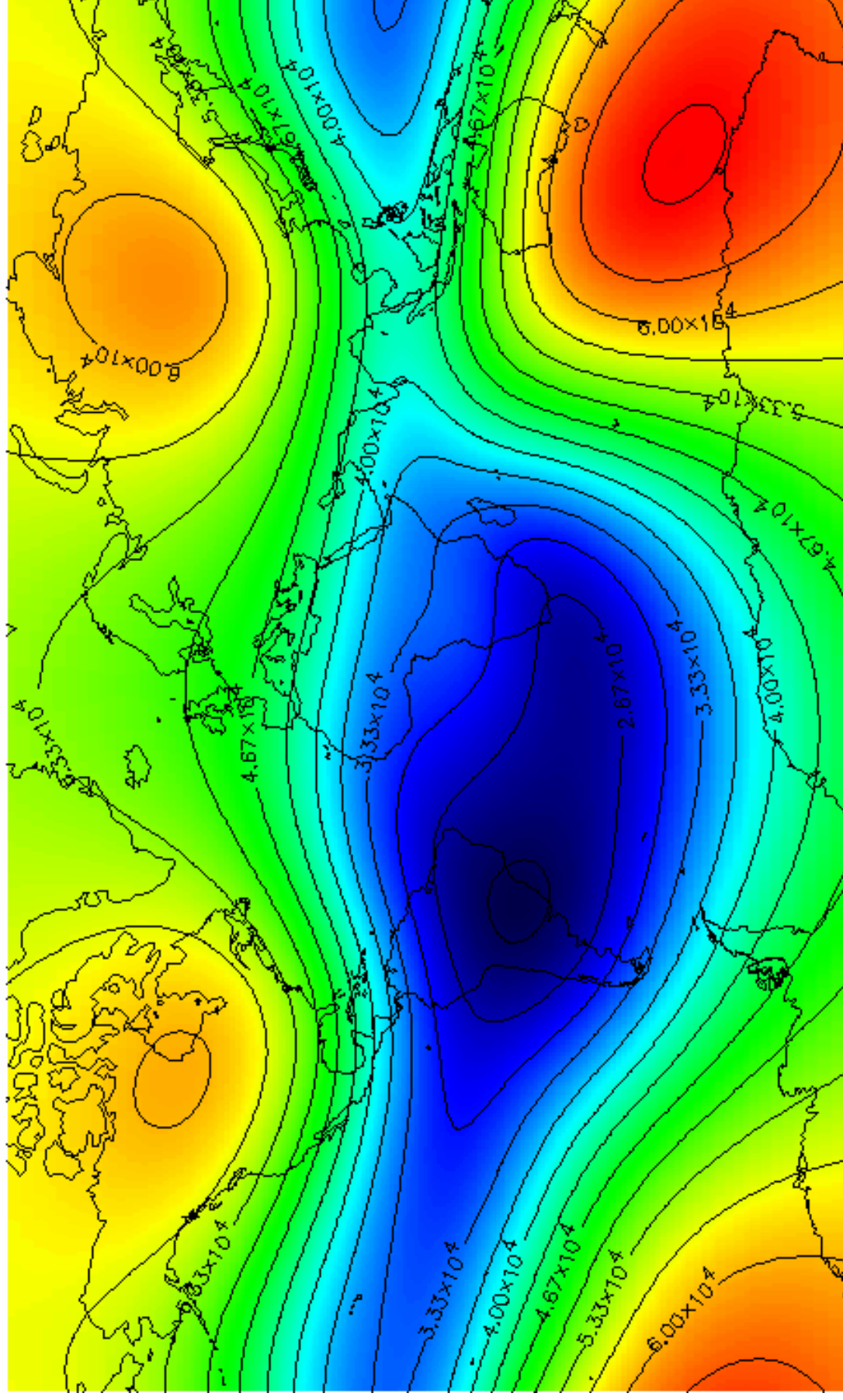
Total field - 1900



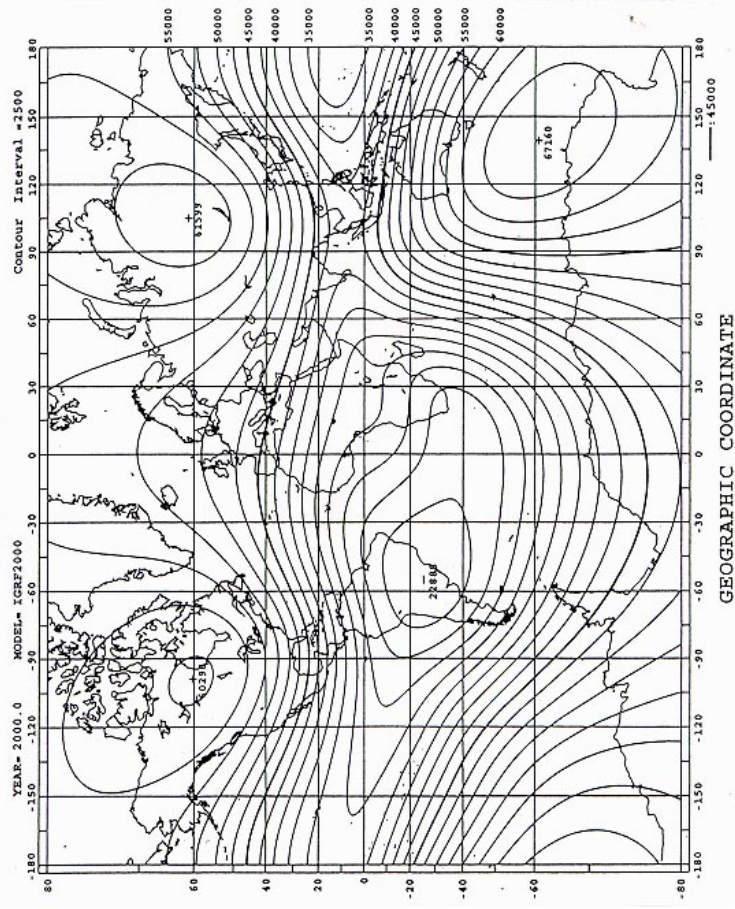
Total field - 1950



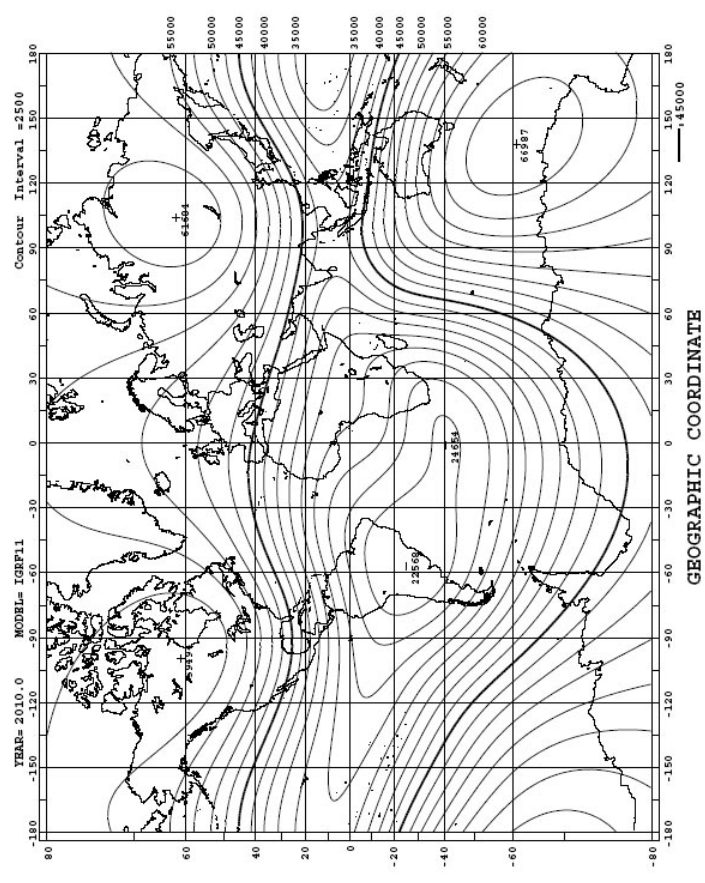
Total field - 2000

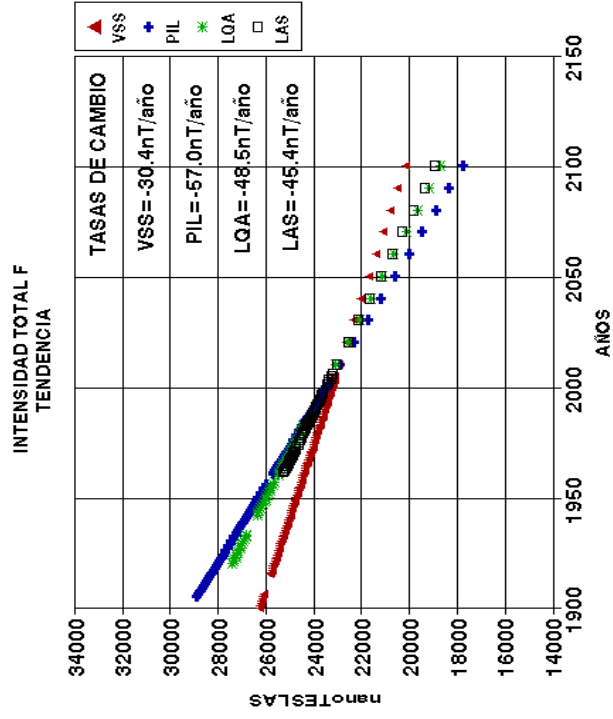
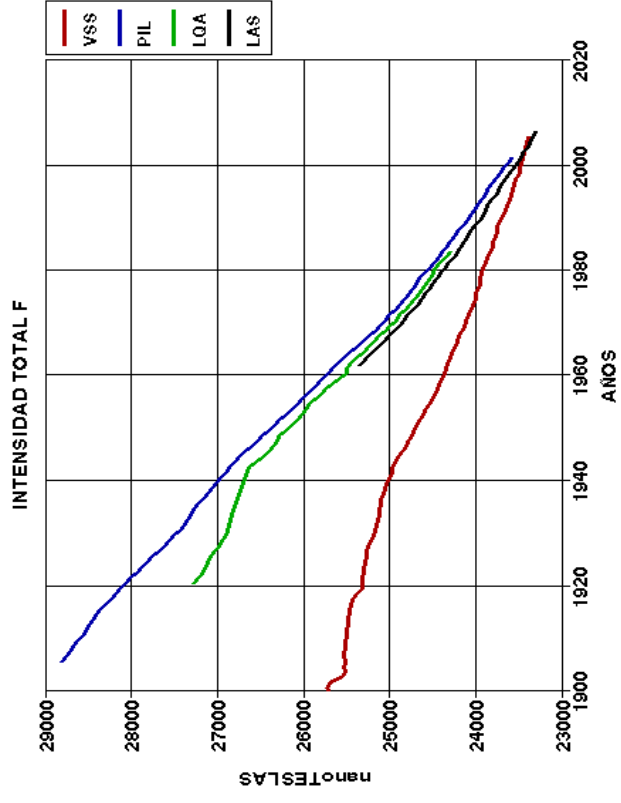
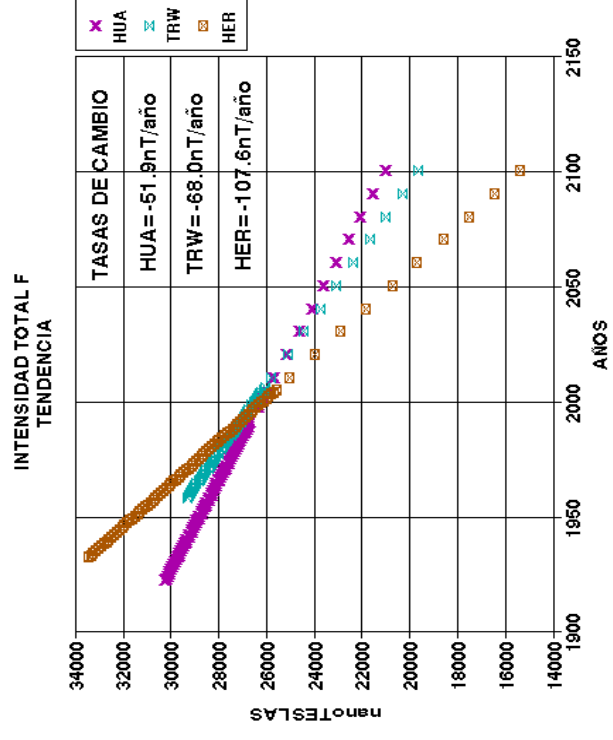
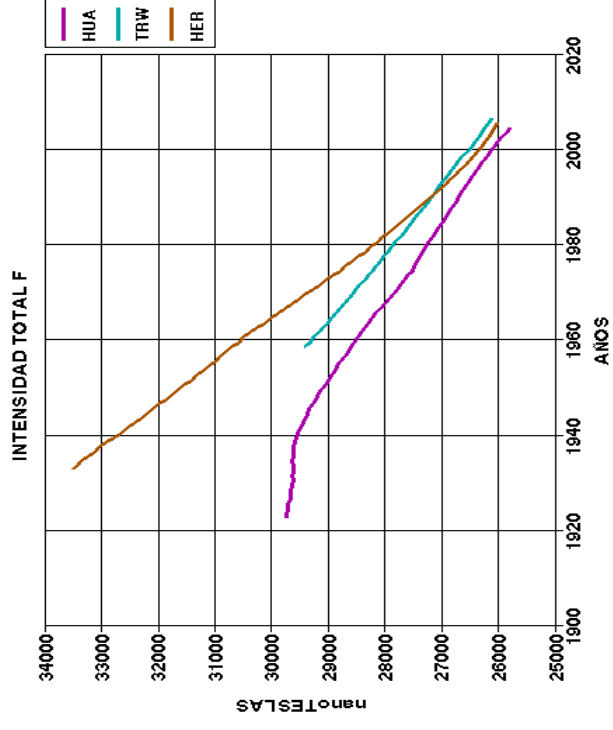


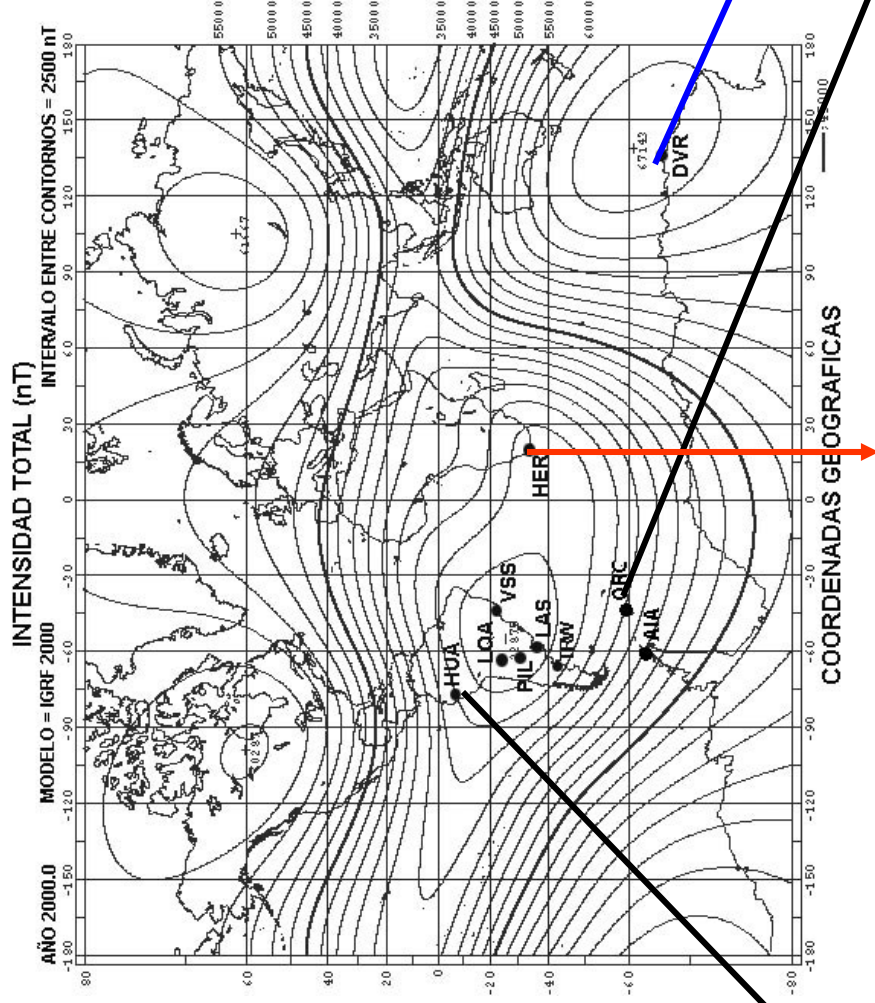
IGRF 2000



IGRF 2010







AÑO	HUA nT	LQA nT	VSS nT	PIL nT	HER nT	LAS nT	TRW nT	ORC nT	AIA nT	DRV nT
2000	26100	23790	23300	23470	26230	23840	26480	33090	39430	69380
2050	23850	21150	21820	20620	20870	21150	23080	27370	34480	67200
2100	21200	18860	20050	17770	15450	18910	19680	21650	29530	64980
ΔF1	- 4900	- 4930	- 3250	- 5700	-10780	- 4930	- 6800	-11440	- 9900	- 4400

FROM ANNUAL MEAN VALUES

AÑO	HUA nT	LQA nT	VSS nT	PIL nT	HER nT	LAS nT	TRW nT	ORC nT	AIA nT	DRV nT
2000	26100	23790	23300	23470	26230	23840	26480	33090	39430	69380
2050	23850	21150	21820	20620	20870	21150	23080	27370	34480	67200
2100	21200	18860	20050	17770	15450	18910	19680	21650	29530	64980
ΔF1	- 4900	- 4930	- 3250	- 5700	-10780	- 4930	- 6800	-11440	- 9900	- 4400

FROM IGRF VALUES

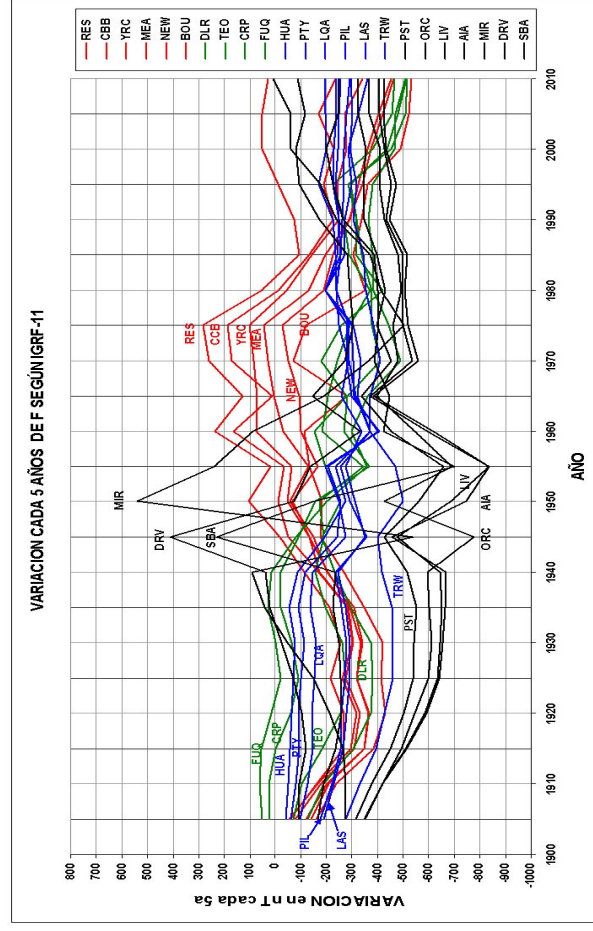
OBS: YEAR	HUA F:nT	LQA F:nT	VSS F:nT	PIL F:nT	HER F:nT	LAS F:nT	TRW F:nT	ORC F:nT	AIA F:nT	DRV F:nT
2000	26069	23507	23431	23622	26358	23593	26844	33630	39889	66693
2050	24138	21382	22388	20962	21273	20990	22906	28526	34385	65587
2100	22208	19257	21345	18301	16188	18387	18968	23421	28882	64480
ΔF 2:	-3861	-4250	-2086	-5321	-10171	-5207	-7875	-10209	-11007	-2213

Discrepancies of estimated values for 2100

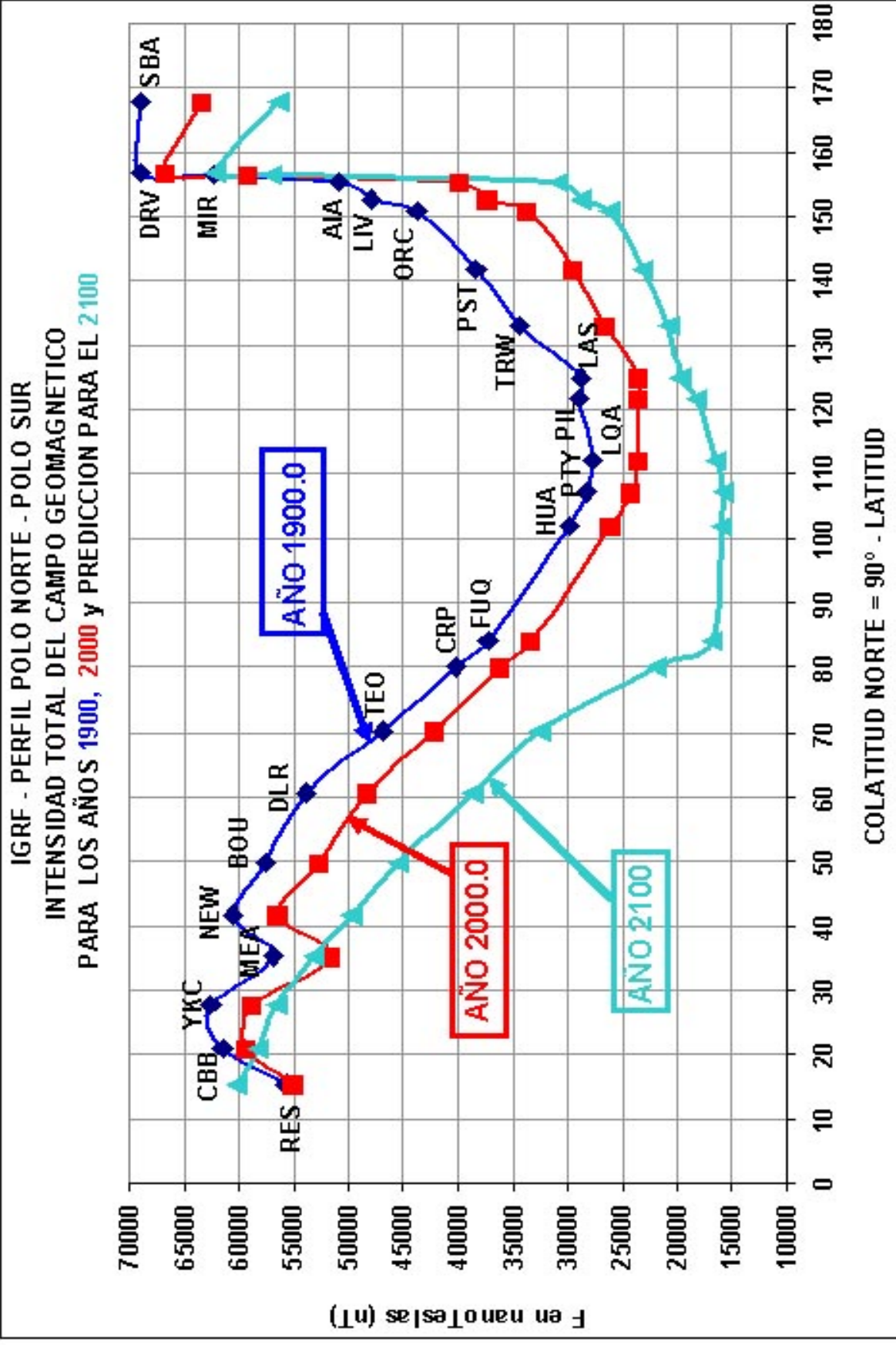
OBS:	HUA F:nT	LQA F:nT	VSS F:nT	PIL F:nT	HER F:nT	LAS F:nT	TRW F:nT	ORC F:nT	AIA F:nT	DRV F:nT
ΔF 1:	-5190	-4930	-3250	-5700	-10780	-4930	-6800	-11440	-9900	-4400
ΔF 2:	-3861	-4250	-2086	-5321	-10171	-5207	-7875	-10209	-11007	-2213
DIFF:	-1329	-679	-1164	-379	-609	277	1075	-1231	1107	-2188

VARIANZA DEL IGRF 11 PARA CADA OBSERVATORIO EN EL INTERVALO 1900 - 2010 EN microTESLAS²

Observatorio	Colatitud (°)	Varianza (microTESLAS ²)
RES	10	0.5
CBB	15	0.8
YRC	20	1.0
MEA	25	1.5
NEW	30	2.0
BOU	40	3.5
DLR	50	4.0
TEO	60	3.5
CRP	70	3.0
FUU	80	3.5
HUA	90	3.0
PTY	100	2.5
LOA	110	3.0
LOA	115	3.5
LAS	120	4.0
PIL	125	4.5
TRW	135	7.5
PST	145	10.0
ORC	150	12.0
LN	155	14.0
ALA	160	14.5
MIR	165	1.5
DRV	168	1.0
SBA	170	15.0



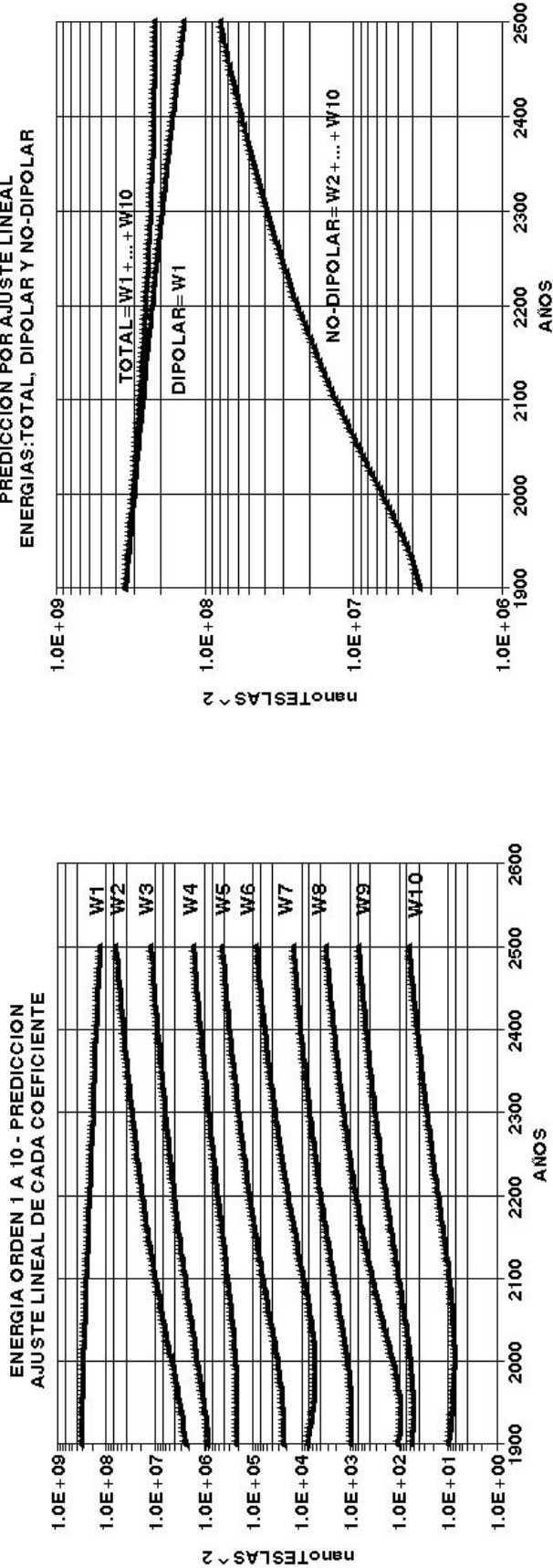
$$\delta F / \delta T = (A + B \cdot T) + \sum C_k \cdot \exp(i\omega_k T + \varphi_k) \quad , \text{ donde } \omega_k = 2\pi / T_k$$

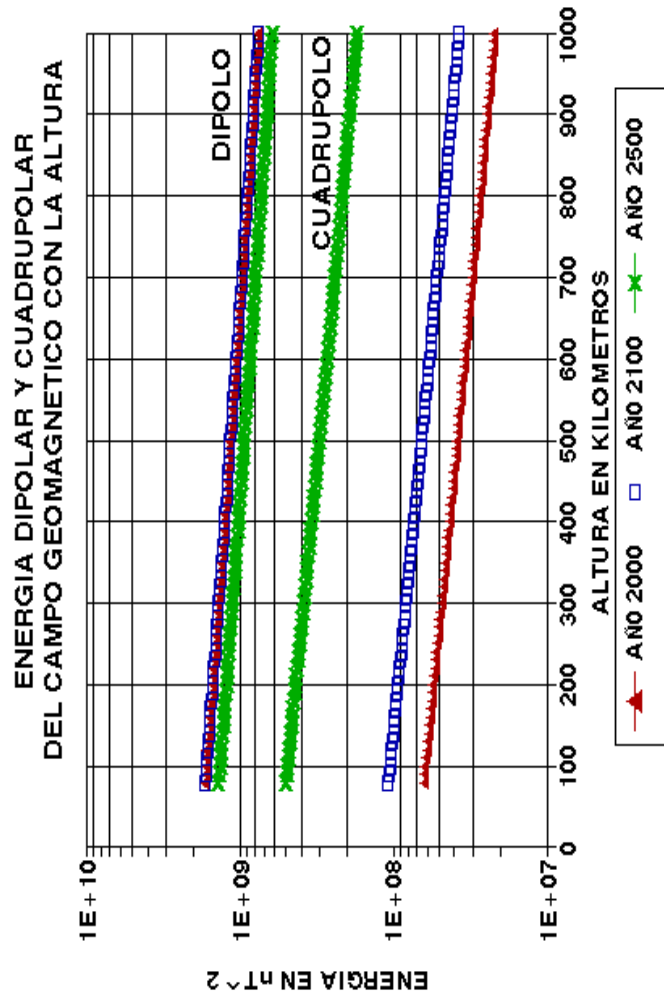
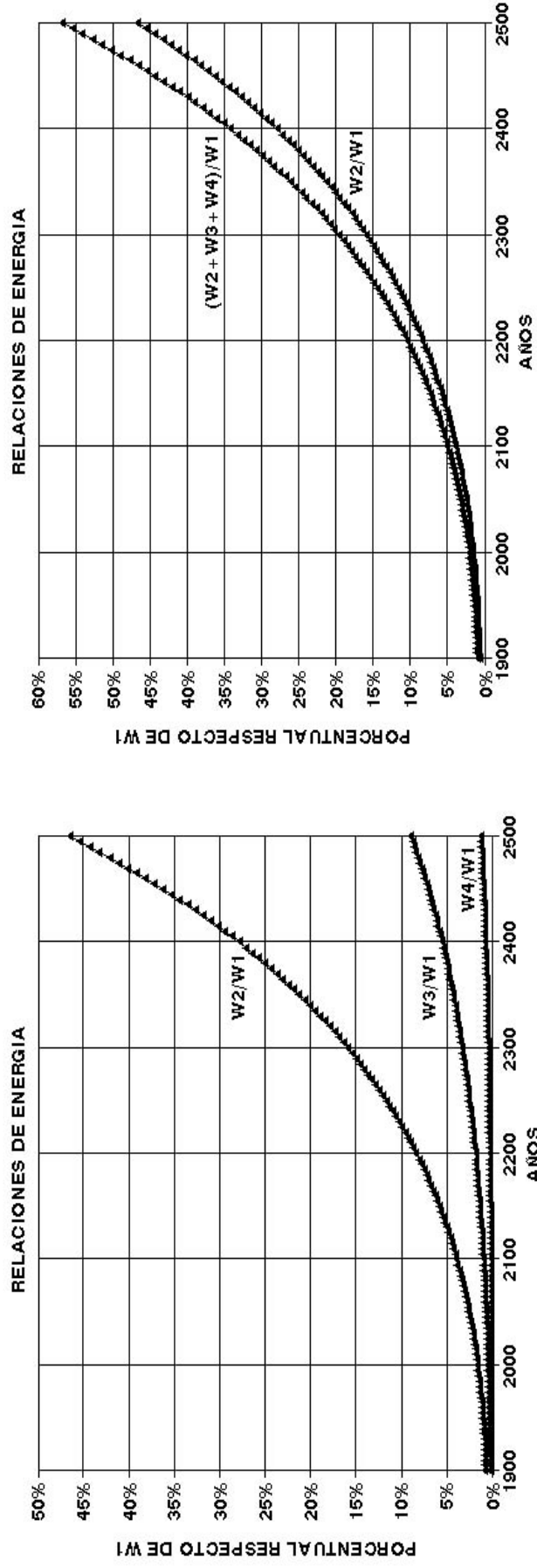


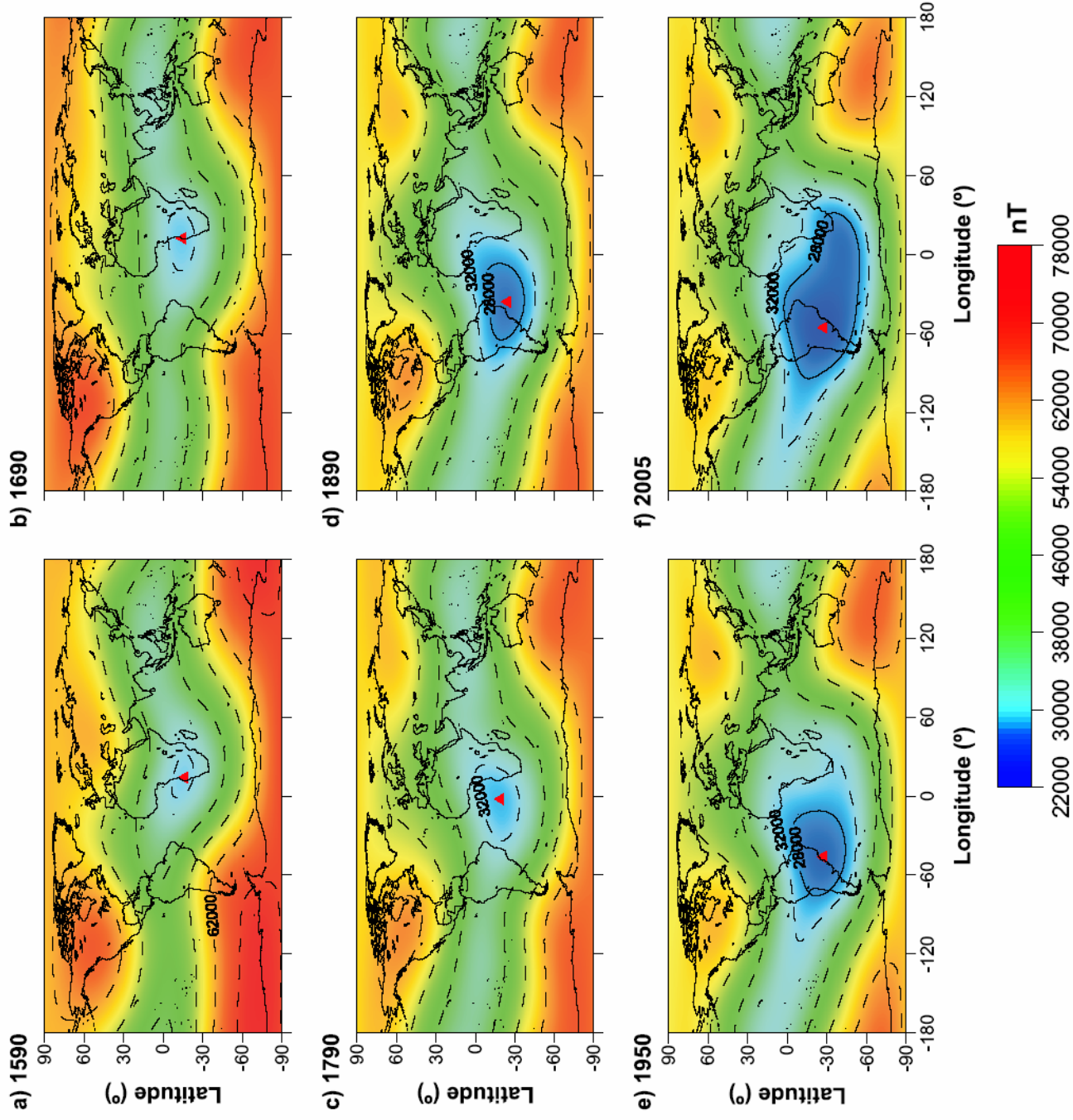
IGRF: 1900 – 2005 CADA 5 AÑOS

$$W_n = \left(\frac{1}{2n+1} \right) \sum_{m=0}^n \left[\left(g_n^m \right)^2 + \left(h_n^m \right)^2 \right]$$

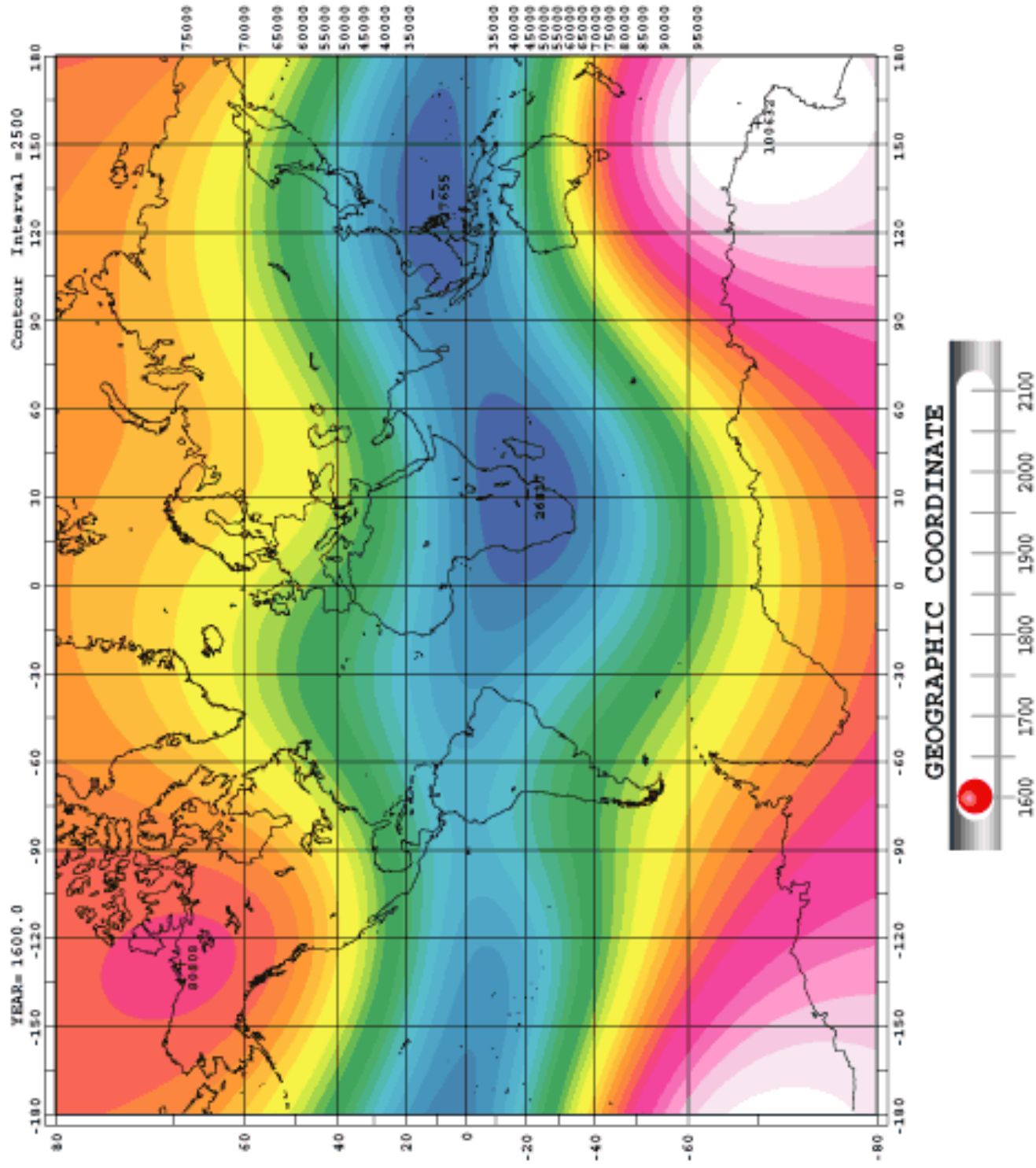
$$1 \leq n \leq 10$$

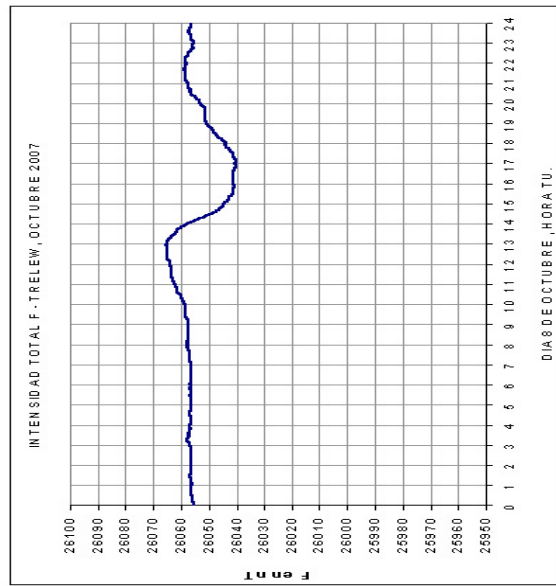
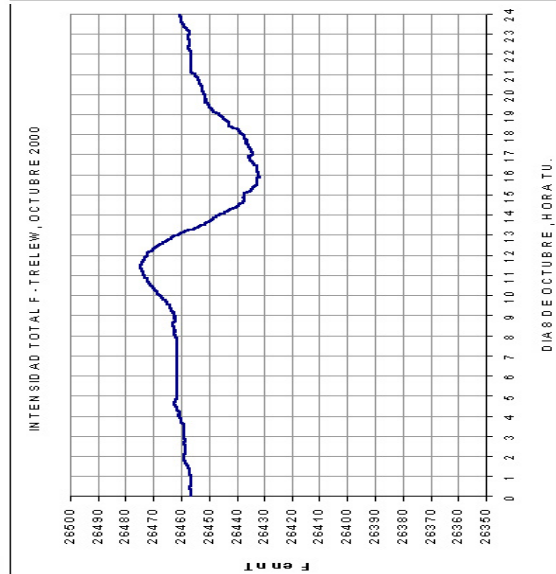
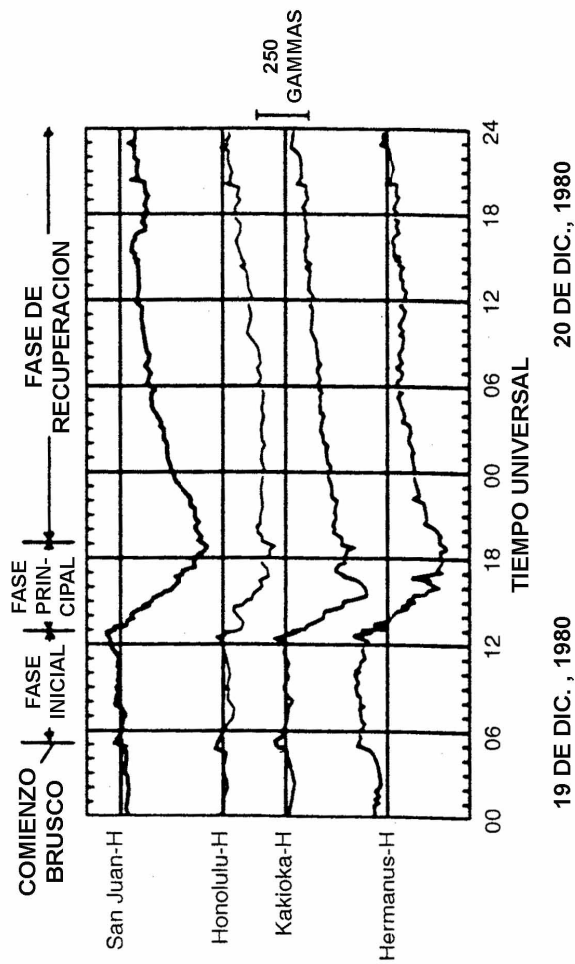
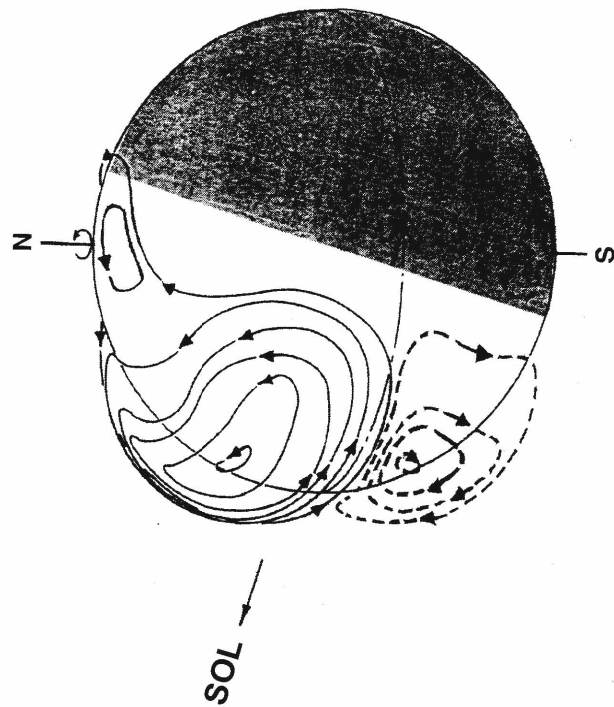
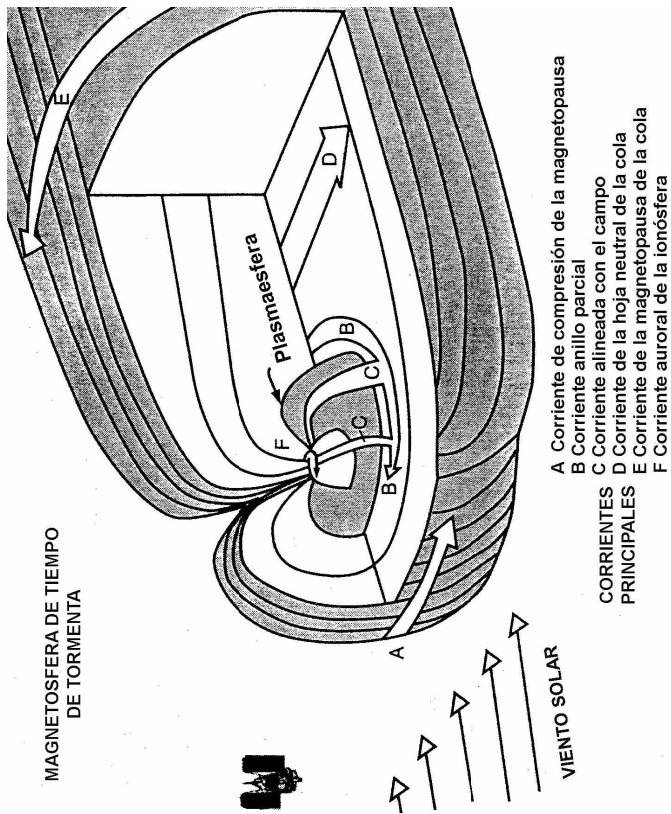




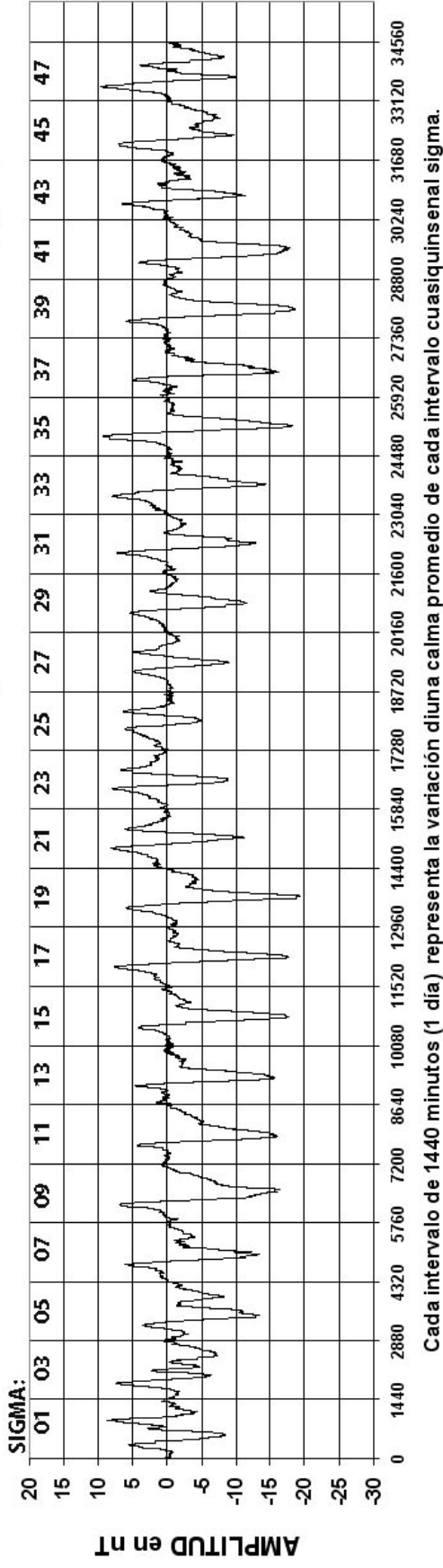


ES FACTIBLE ESTA SITUACION?

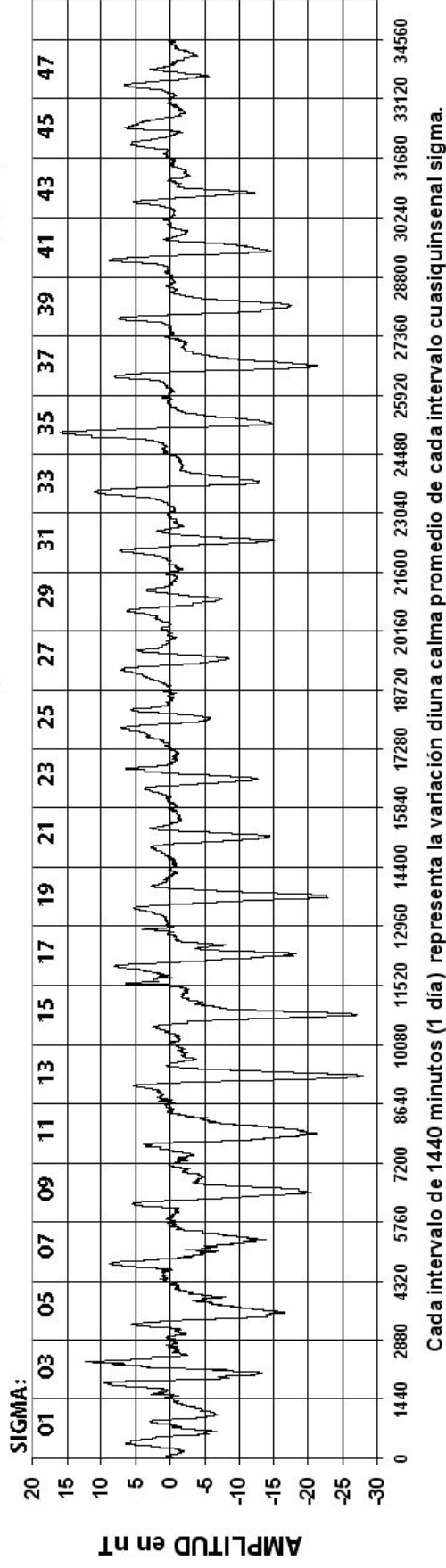




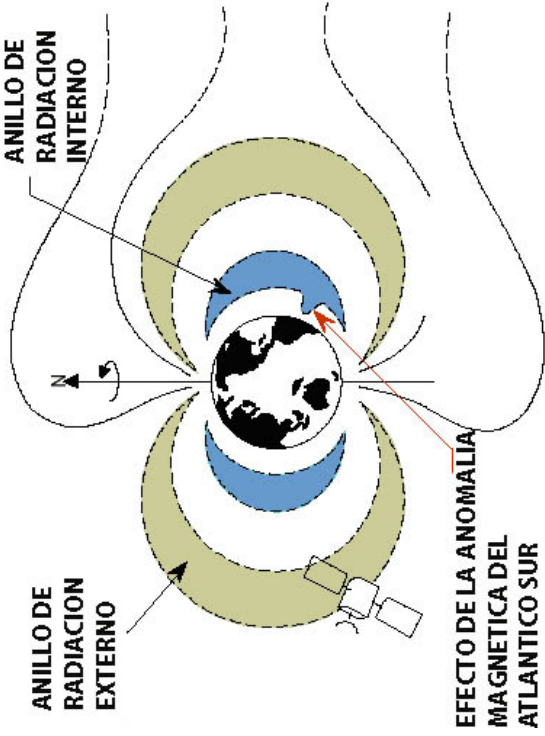
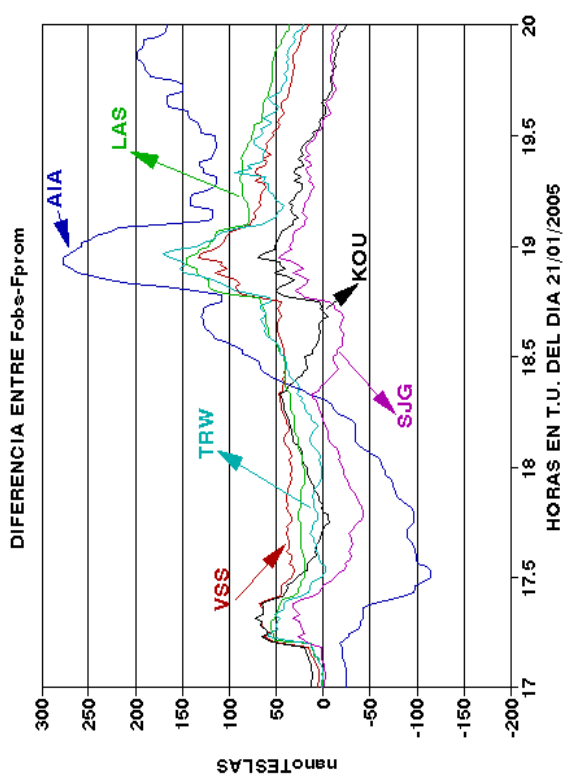
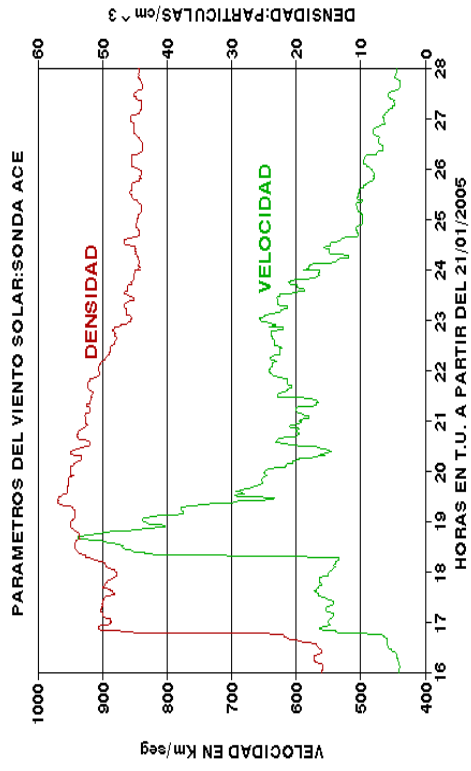
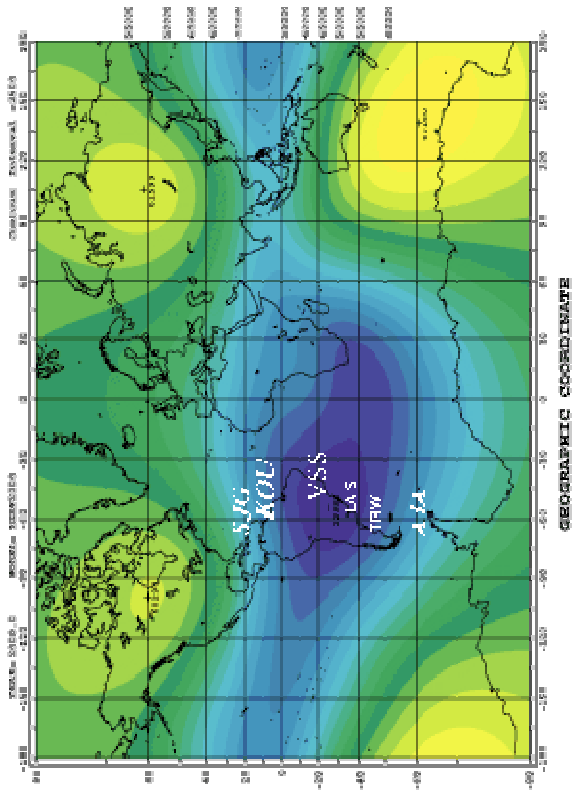
TRELEW 2007 - Gráfico de la variación diurna calma de F según el numero estacional de Bartels (sigma)



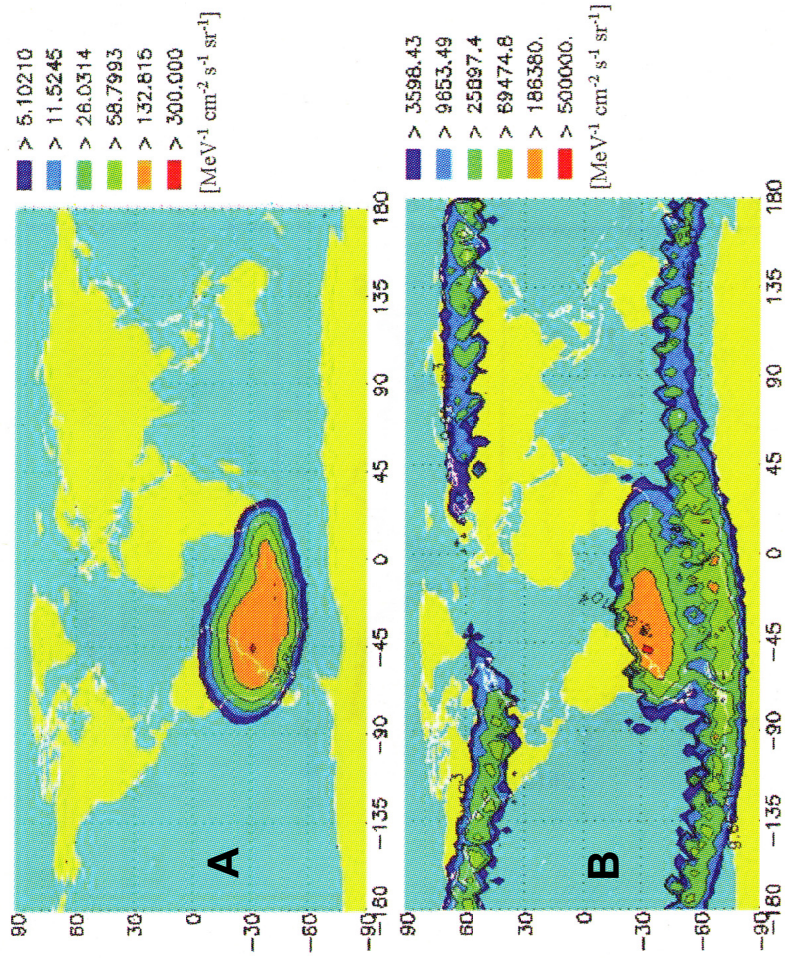
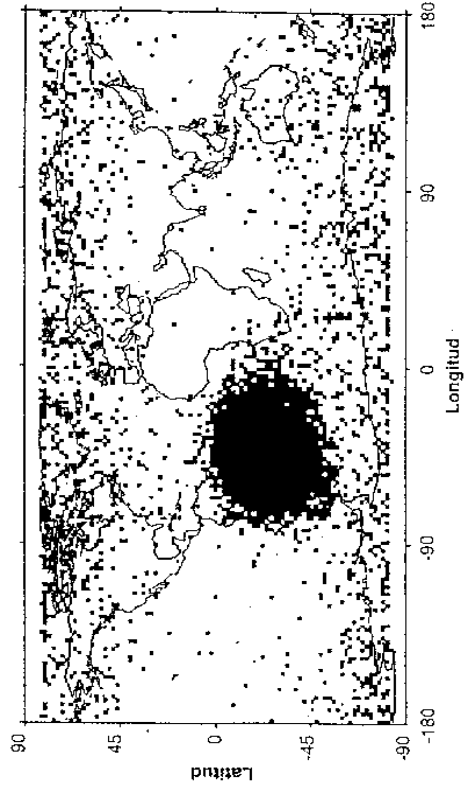
TRELEW 2008 - Gráfico de la variación diurna calma de F según el numero estacional de Bartels (sigma)



LOS CINTURONES DE RADICION Y LA ANOMALIA DEL ATLANTICO SUR



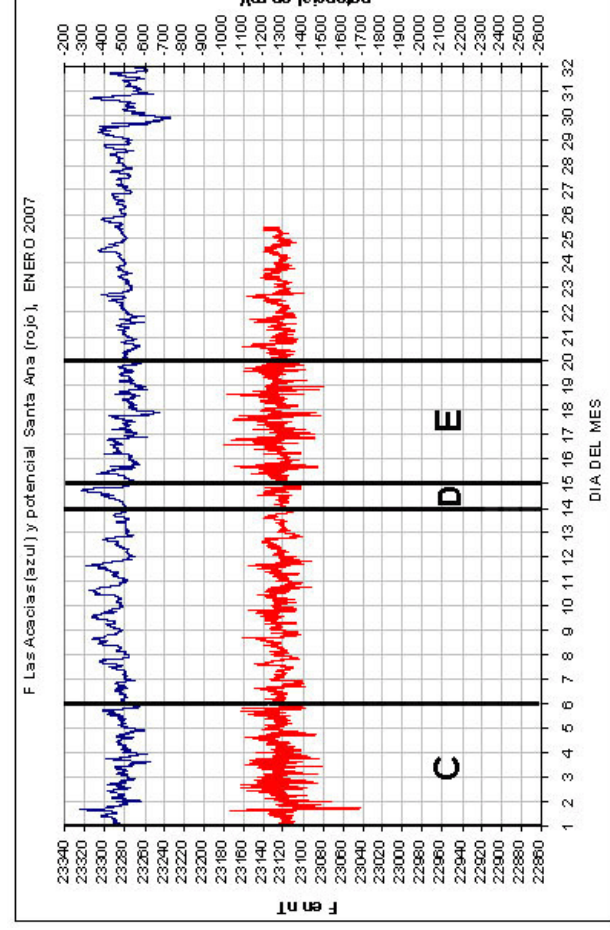
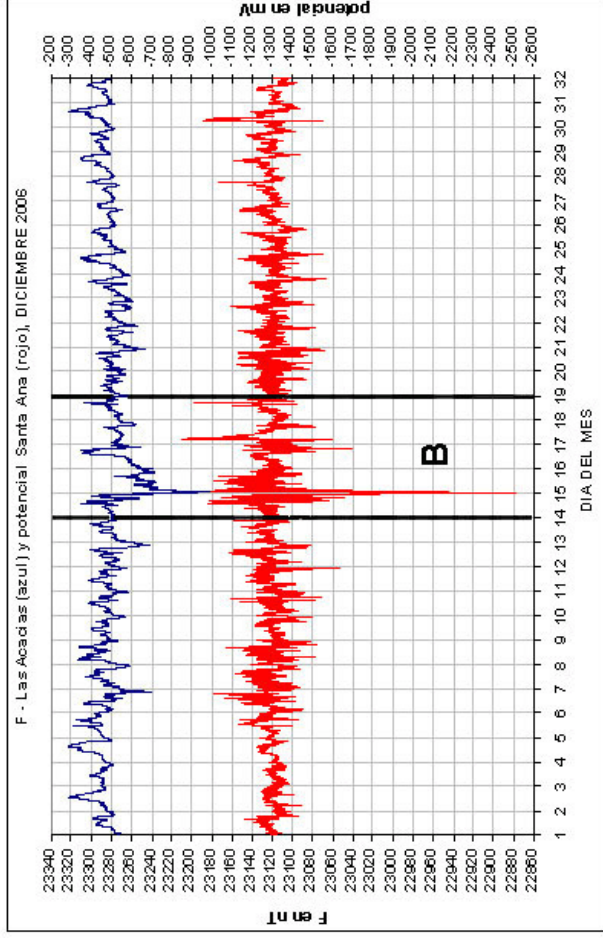
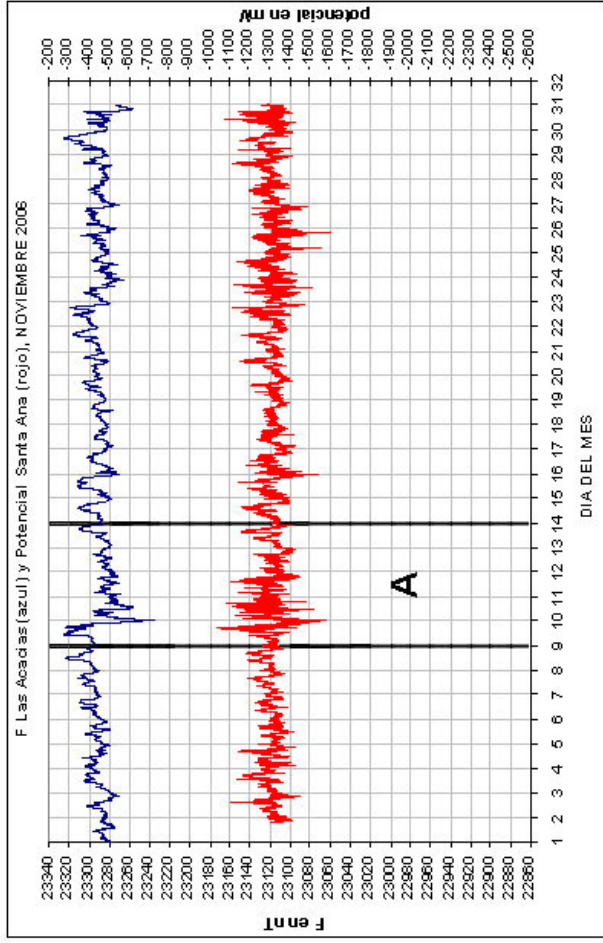
EFFECTOS AERONOMICOS DE LA AMAS



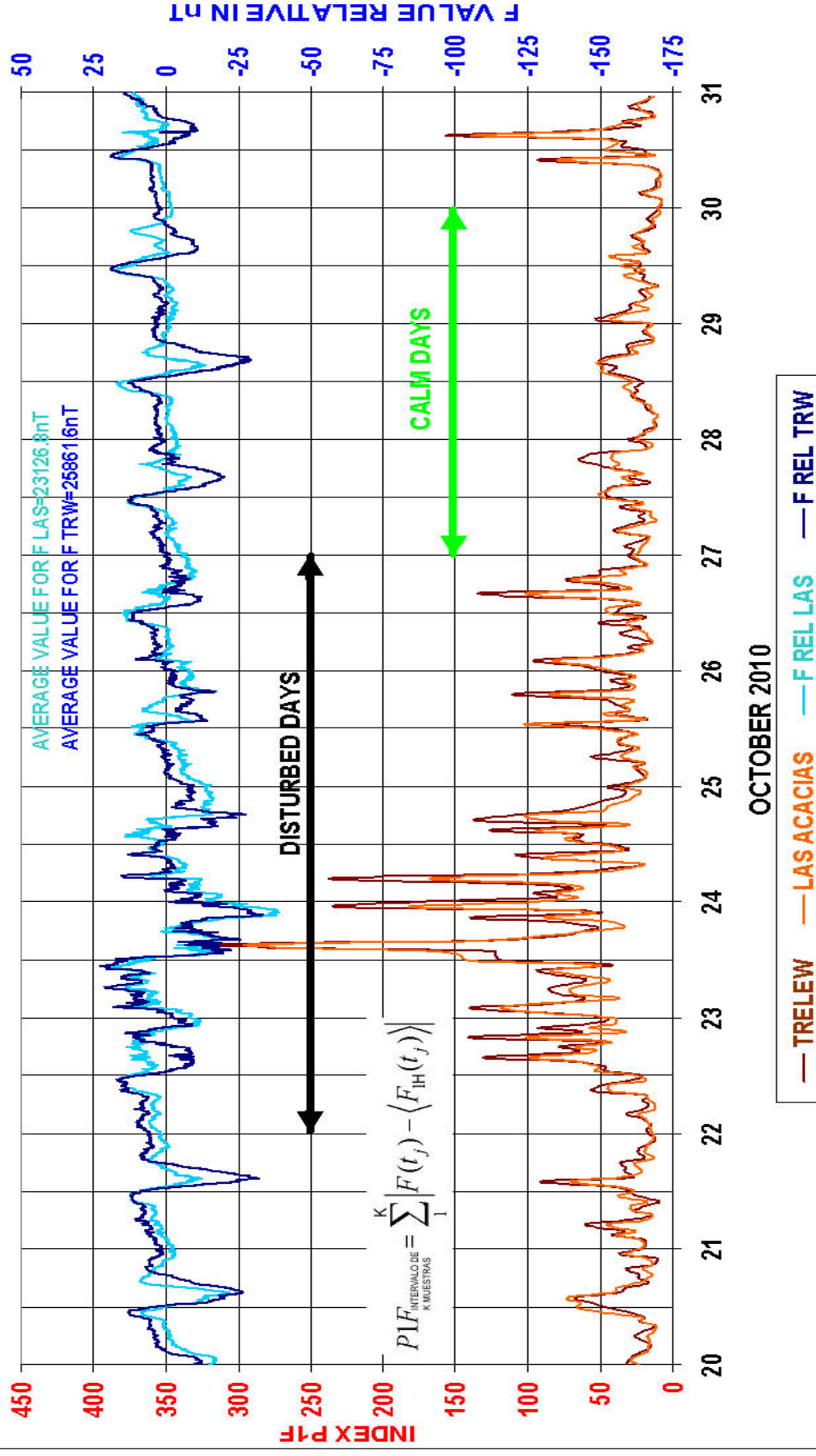
CURVAS DE IGUAL FLUJO DE PARTICULAS OBTENIDAS POR EL DETECTOR SPICA INSTALADO EN EL SATELITE "SAC C" A UNA ALTURA DE 710km.

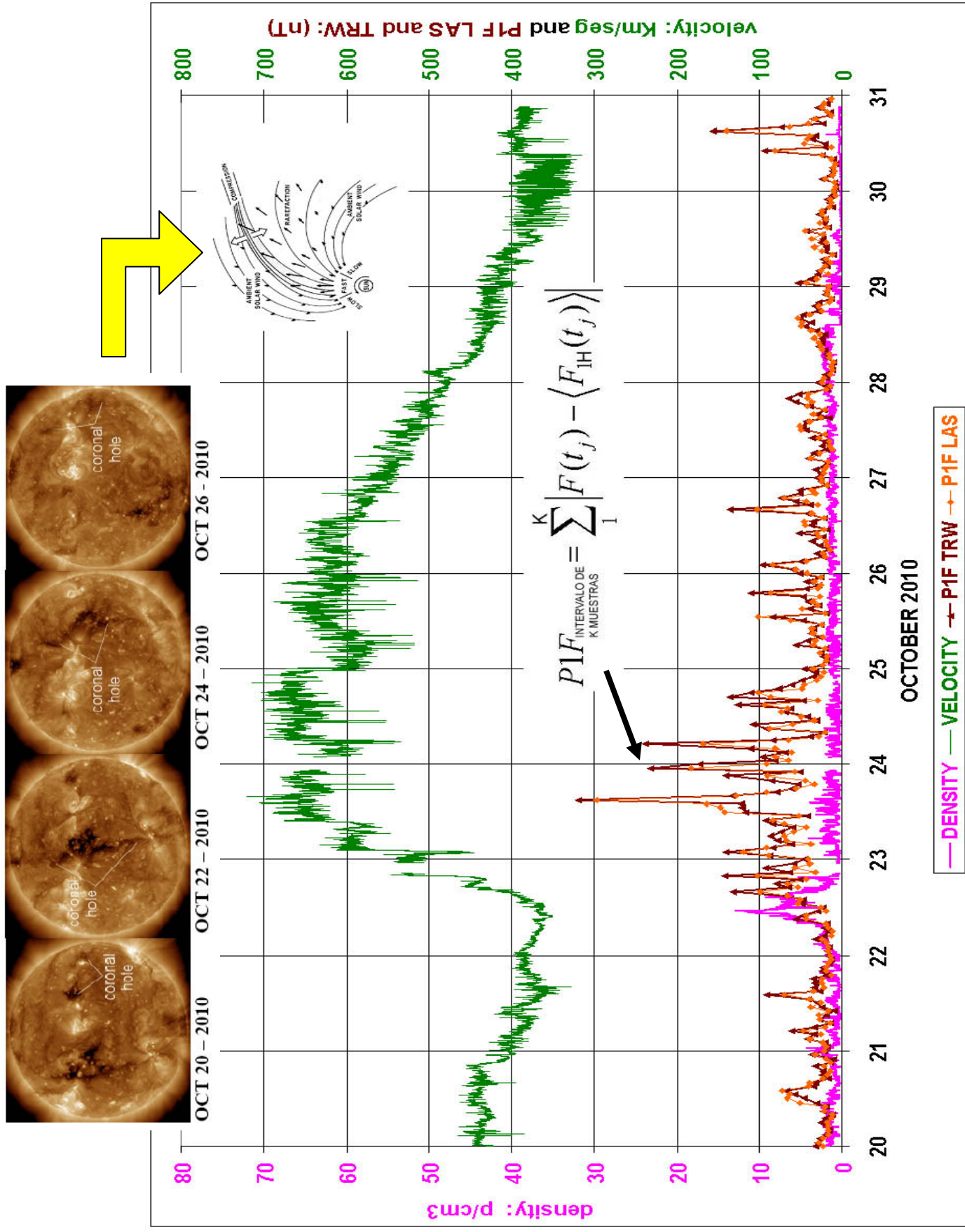
A) PROTONES DE 9.4MeV

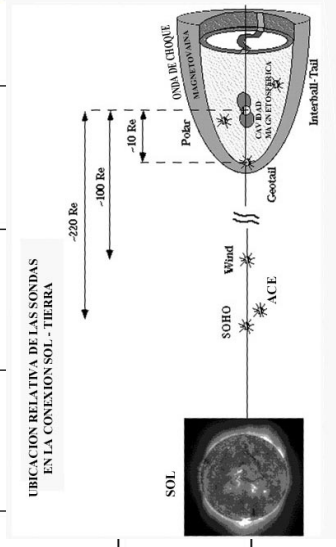
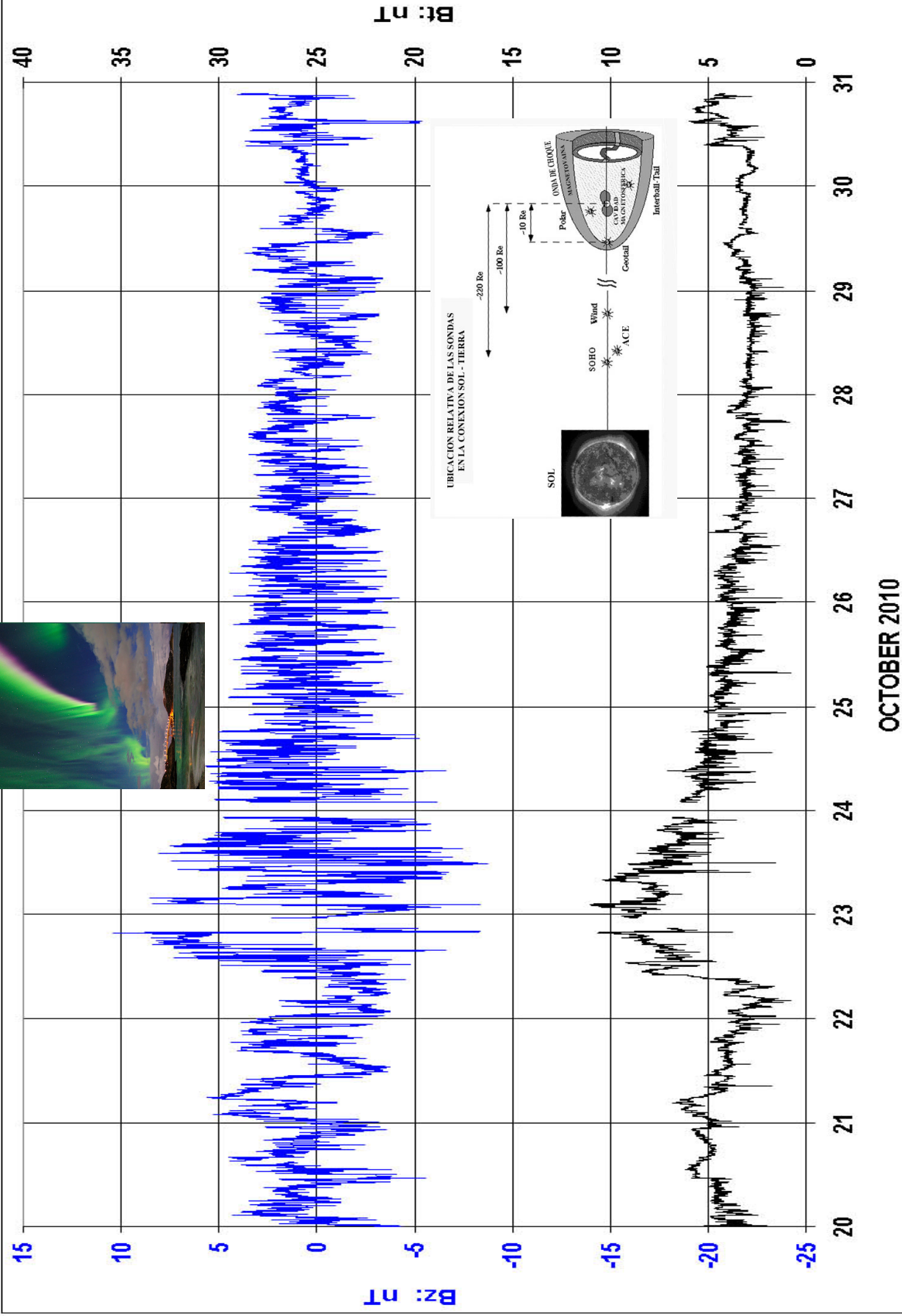
B) ELECTRONES DE 460keV



OCTOBER 20 TO 30-2010. P1F INDEX and RELATIVE VALUES for F from THE AVERAGE







Imaging Riometer (IRIS) Installed at South America

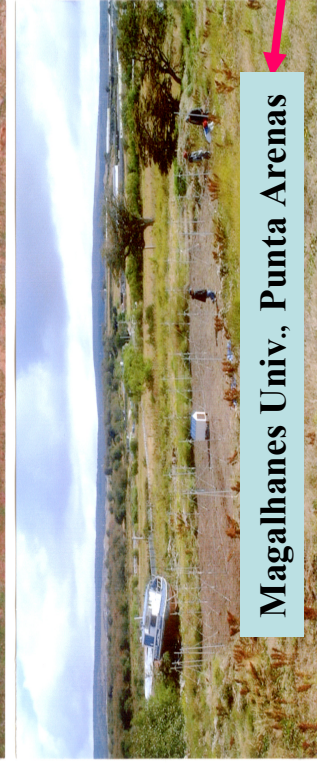
29°42'S,
53°11'W



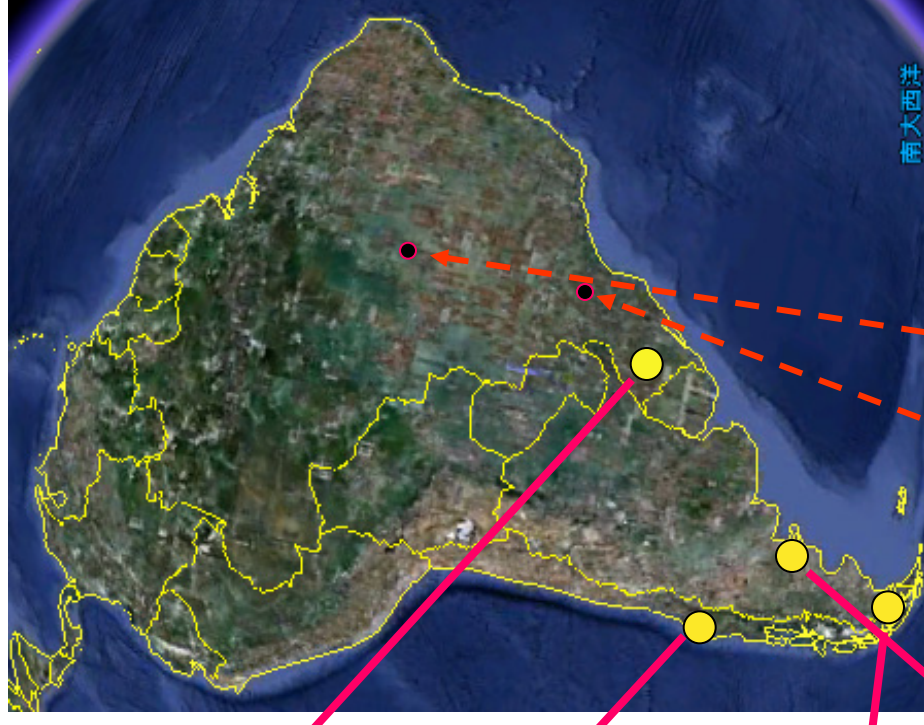
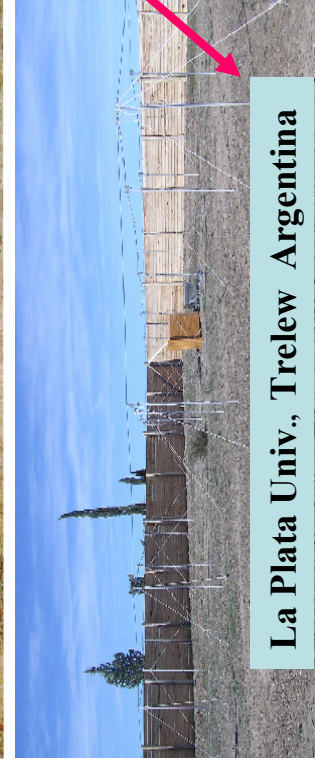
36°50'S,
73°01'W



53°07'S,
70°53'W

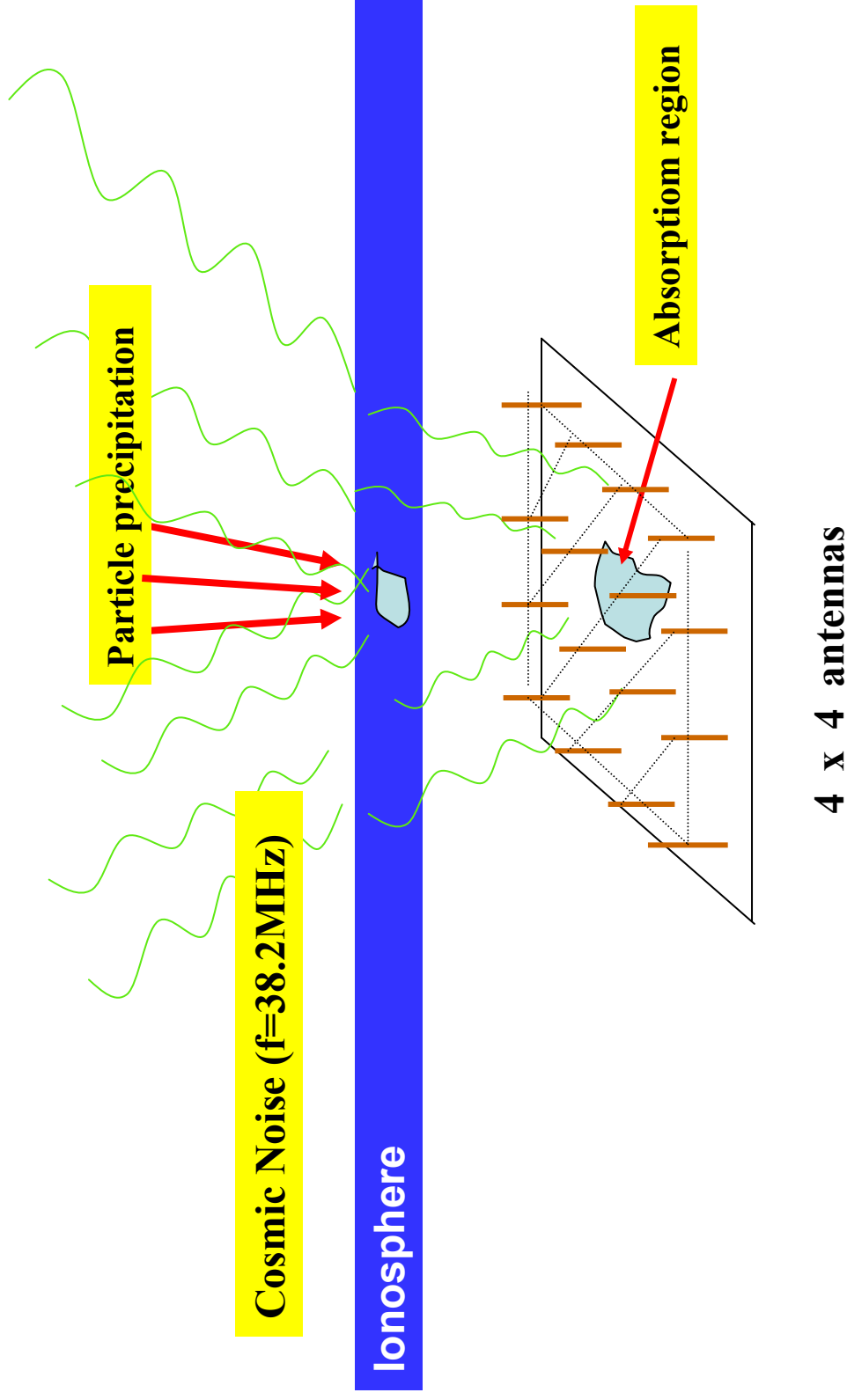


43°15'S,
65°22'W



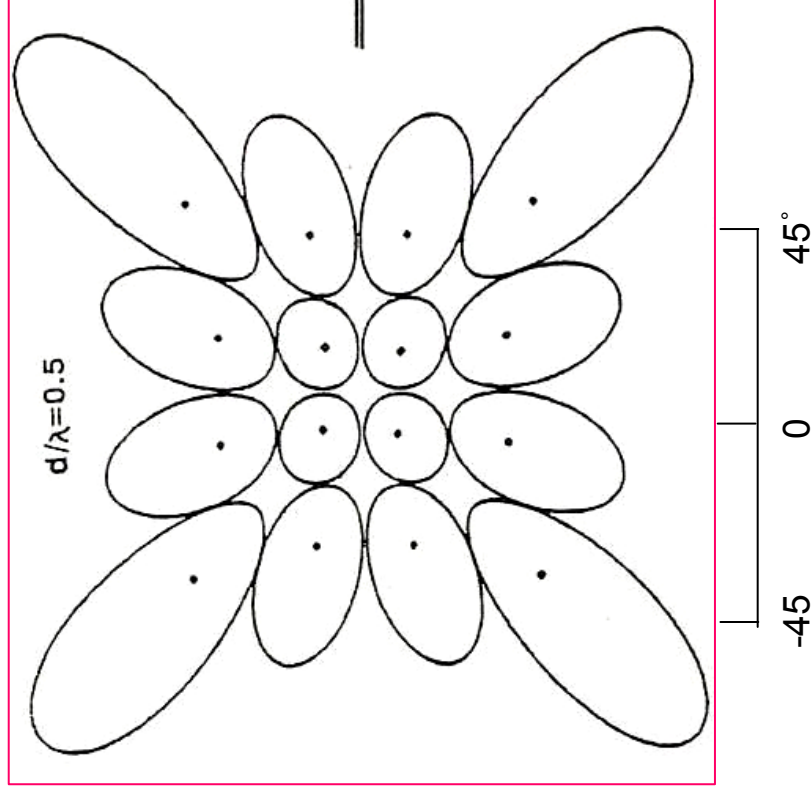
Planning :
UNIVAP, San José dos Campos
ULBR, Palmas

Imaging riometer system

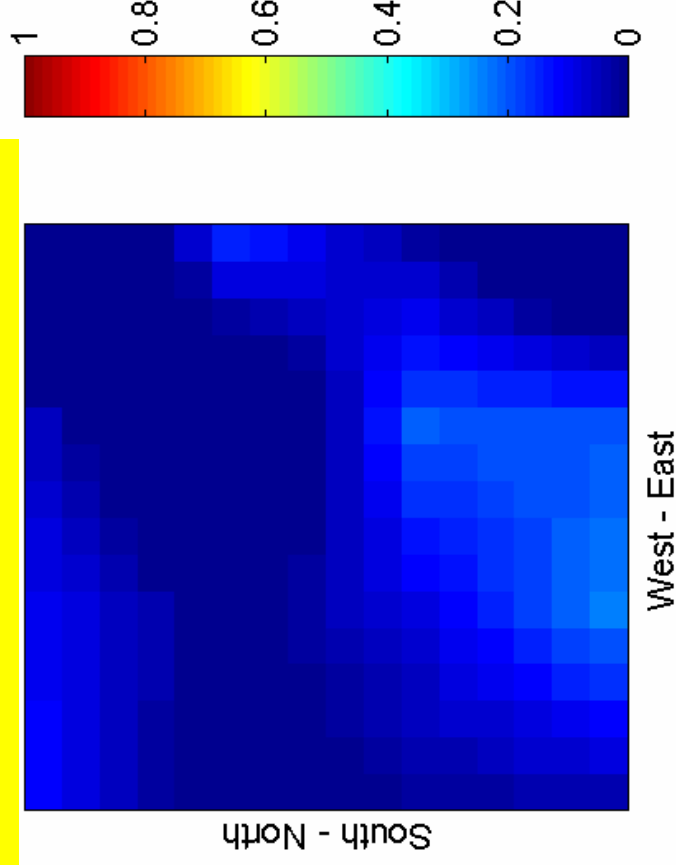


$f=38.2\text{MHz}$

IRIS antenna (4 X 4)



2006/12/17 04h00mUT



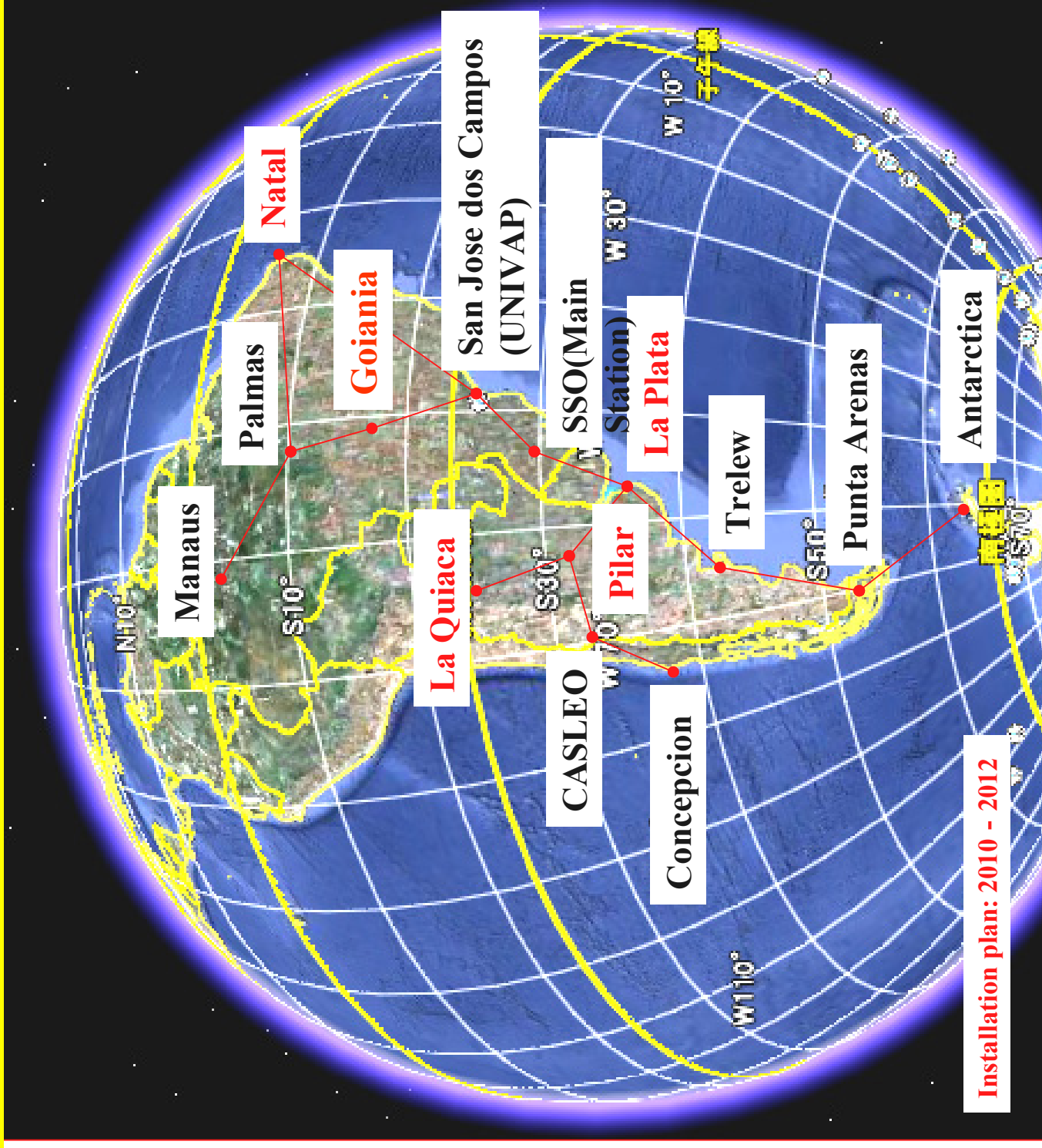
For Example, : Phenomena at 100km altitude

Cover Area : >200km , Sensitivity : 20km

Imaging Riometer/ 1ch Riometer at Trelew Geomagnetic Observatory

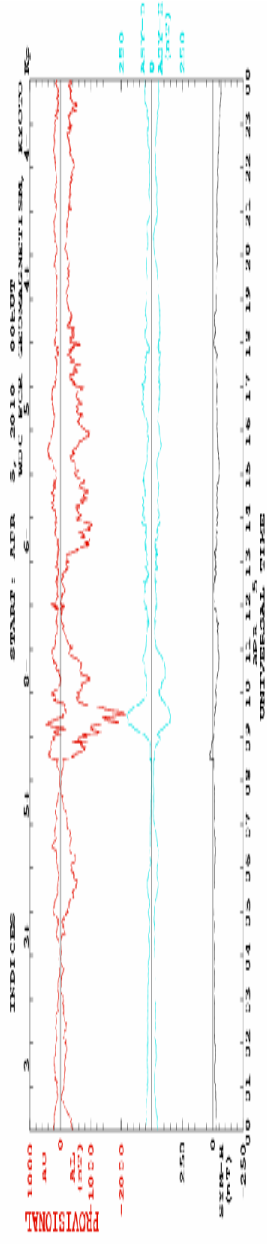


South America Riometer Net work (SARINET): IRIS and 1ch Riometer

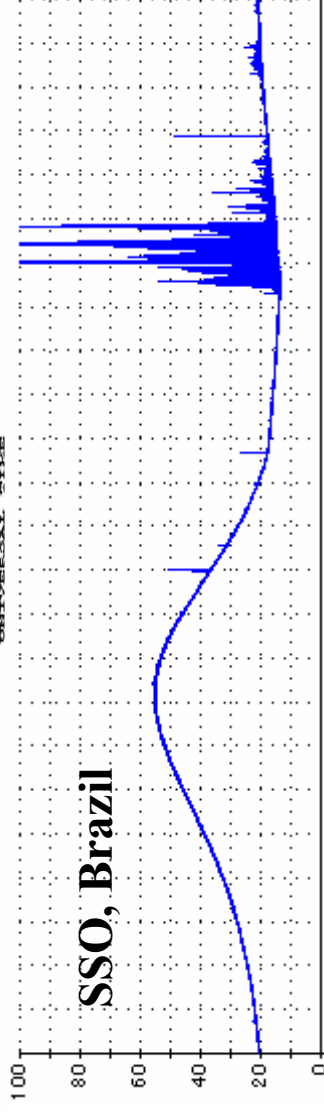


April 05, 2010. (Solar burst Event) SARINET 1channel

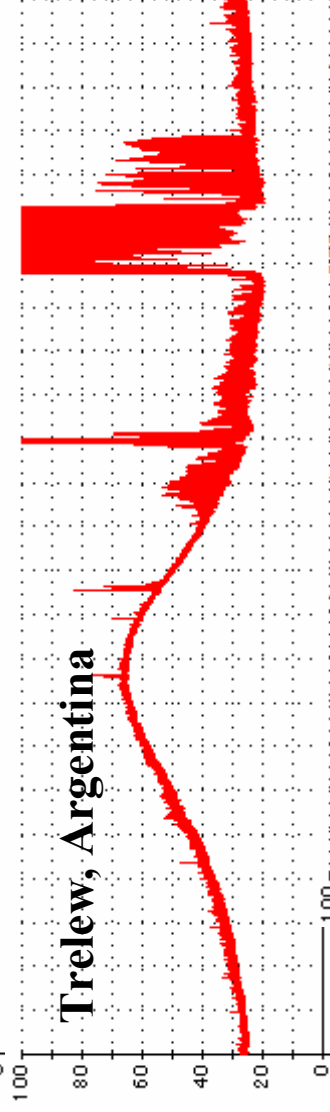
Riometer



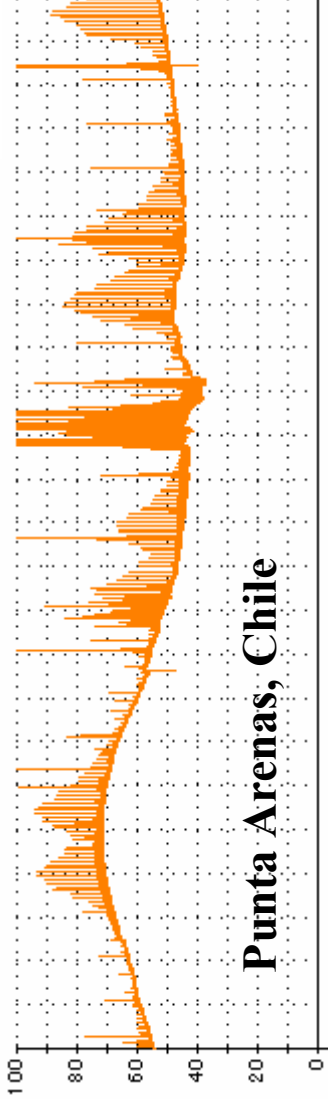
SSO, Brazil



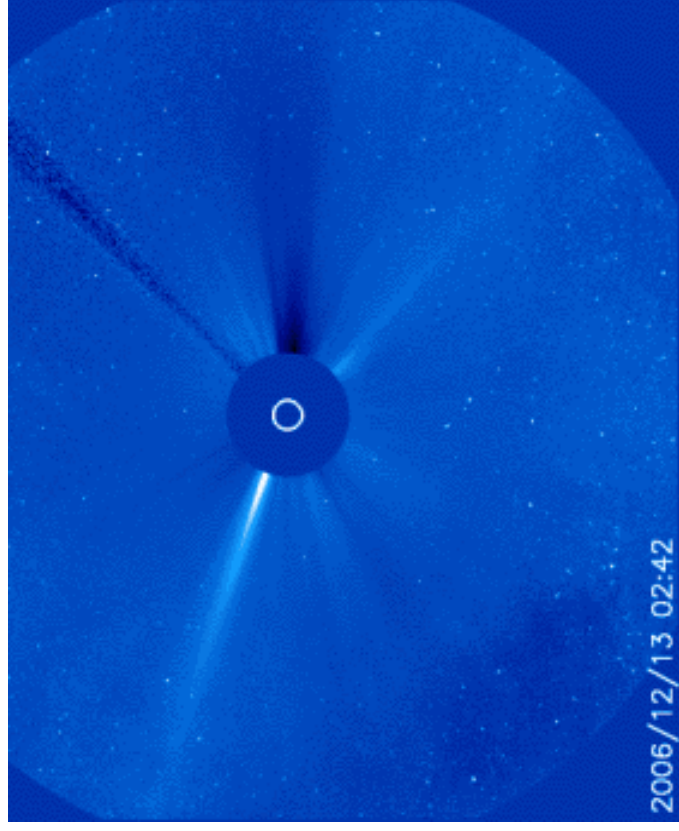
Trelew, Argentina



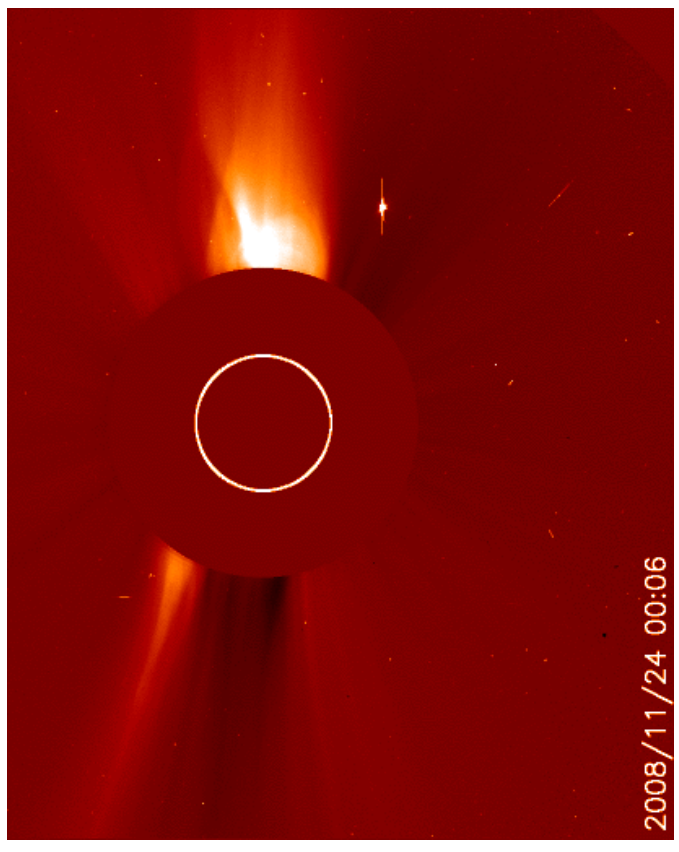
Punta Arenas, Chile



CME DEL DIA 13 DE DICIEMBRE DE 2006



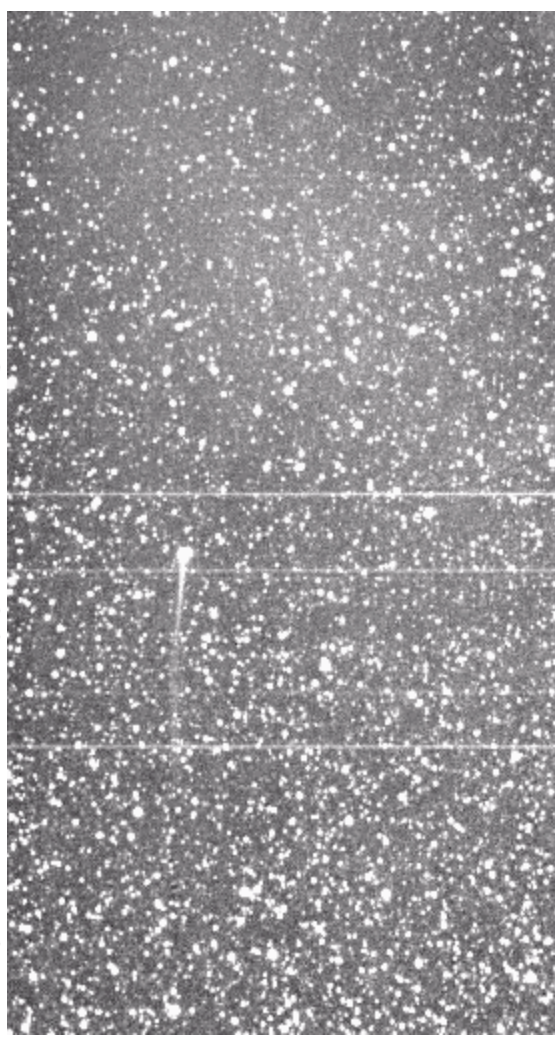
EYECCION DE MASA CORONAL NOV 24-2008



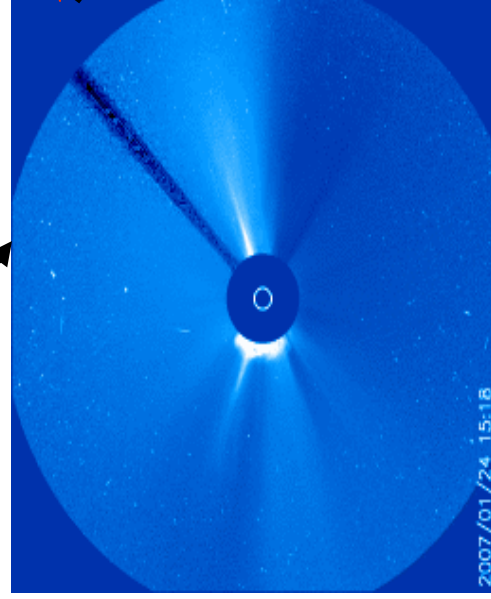
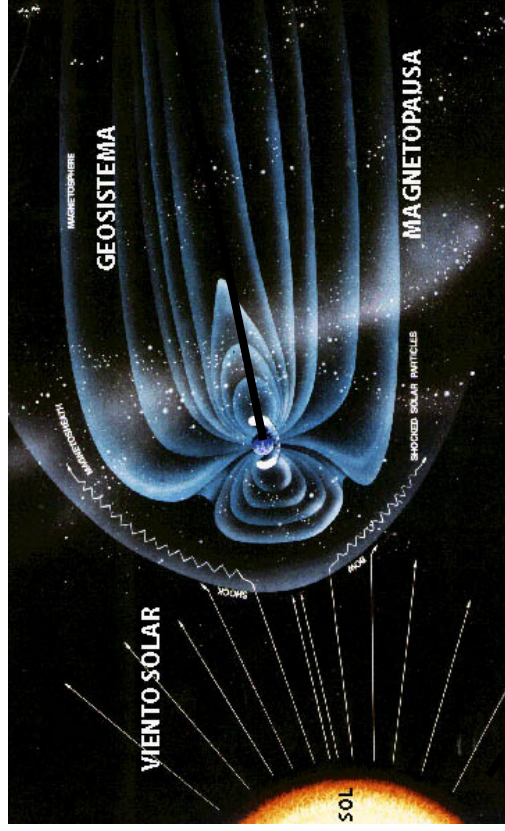
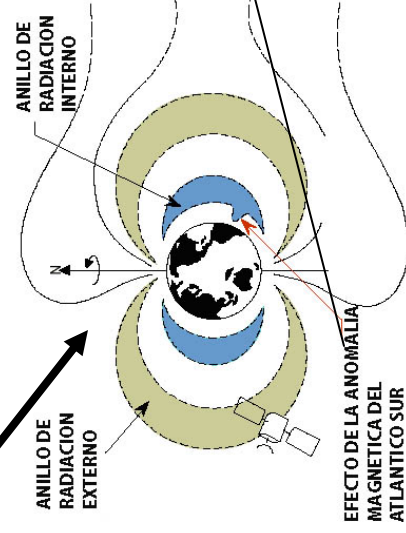
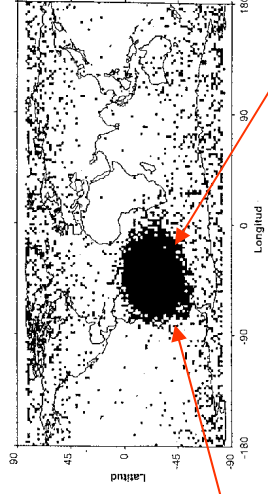
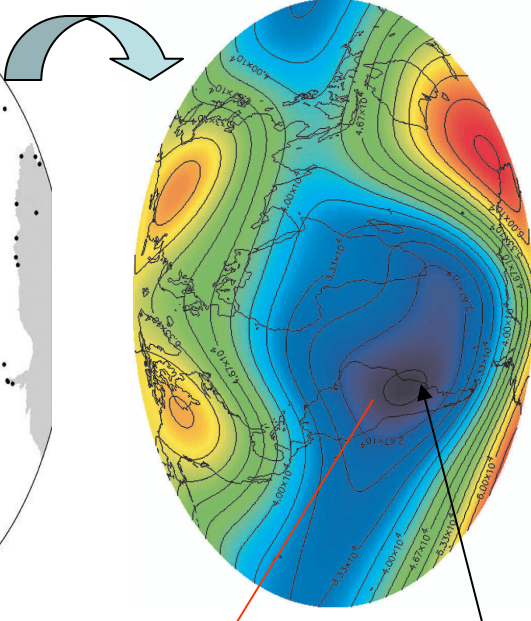
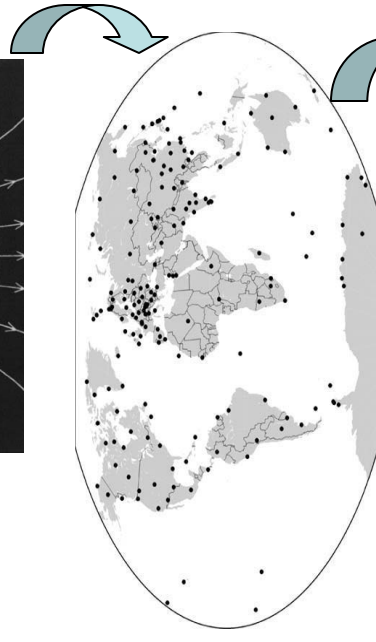
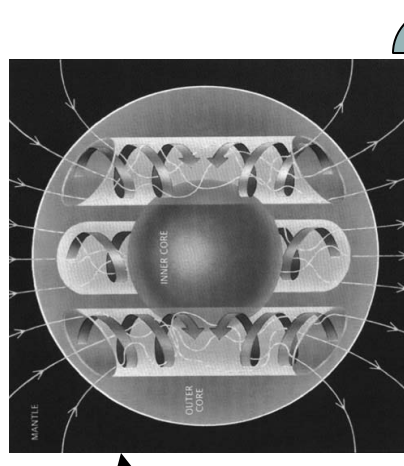
SONDA STEREO

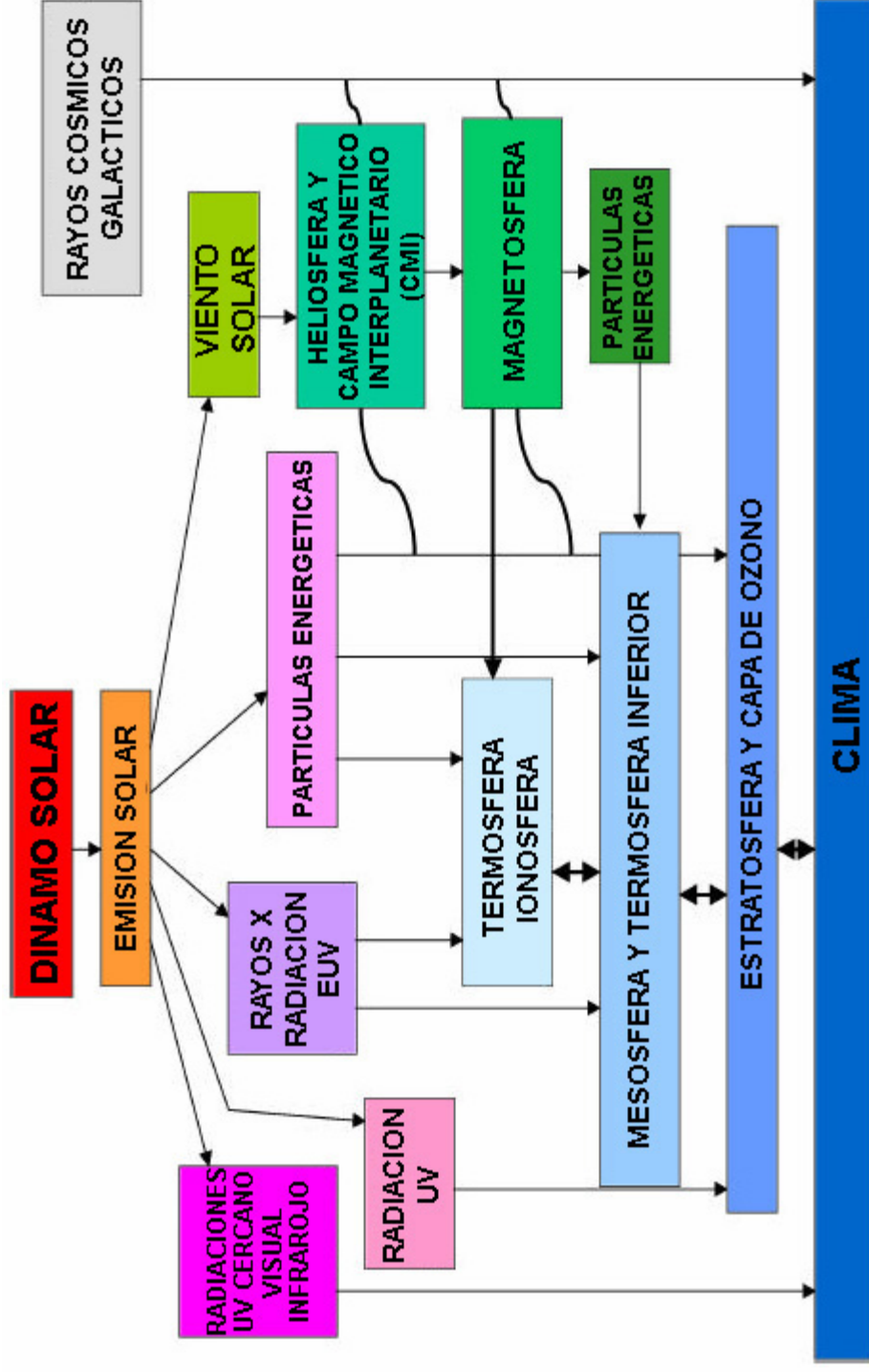


20 DE ABRIL 2007: EMC COMETA ENCKE



LOS CAMBIOS DEL GEOSISTEMA





Diseñar un índice de actividad diario a través del rango de actividad determinado para F según norma L1.

Evaluar su evolución temporal, a través del ciclo solar.

Se presenta el ejemplo para el Observatorio Magnético de Trelew.

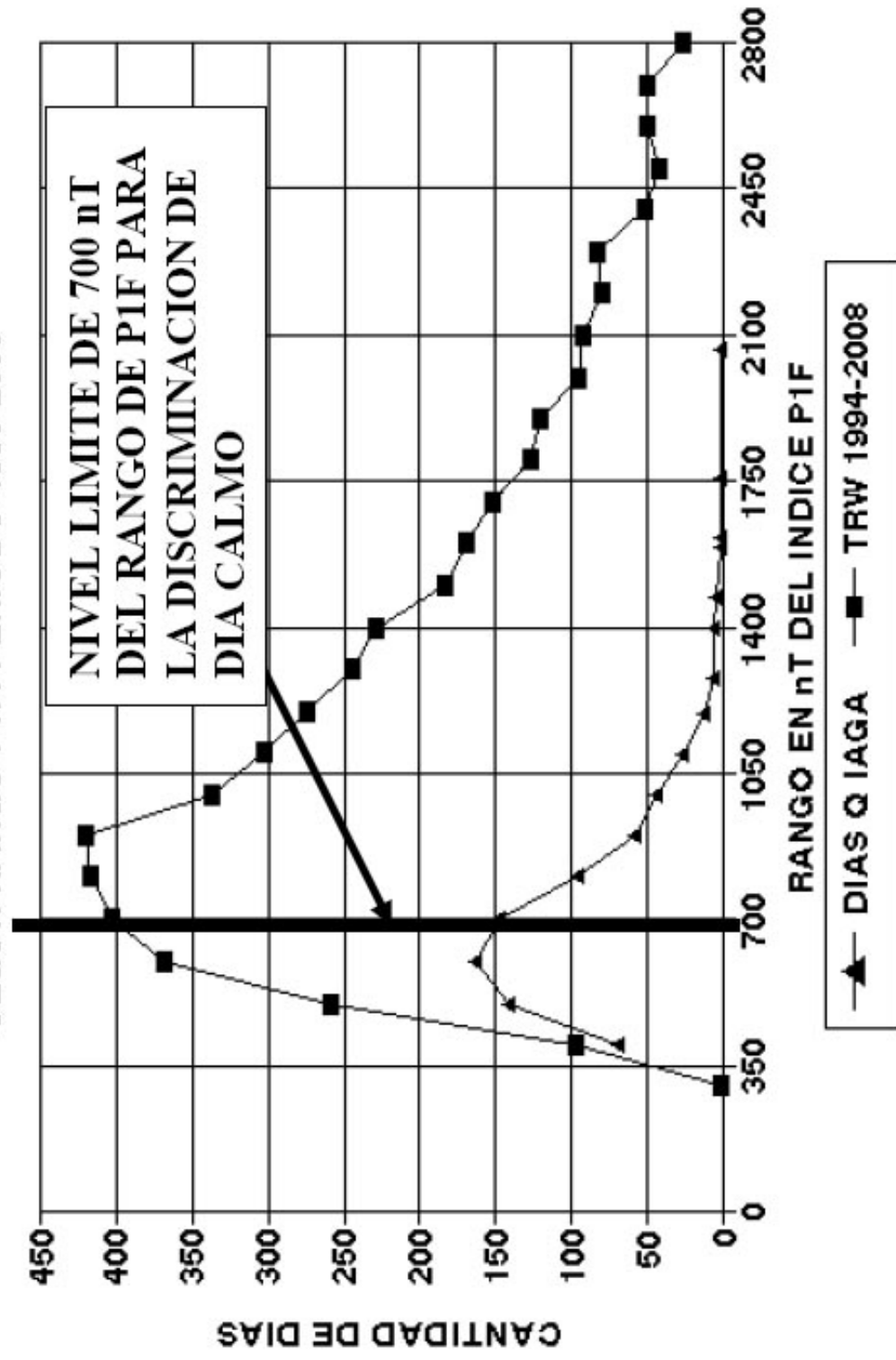
Los días mas calmos son detectados a partir de la un nivel determinado y se comparan los resultados con los días Q1, Q2 y D seleccionados por la IAGA y todos los días del ciclo solar 23.

Determinar para los Observatorios Seleccionados en tiempo solar local los niveles de actividad.

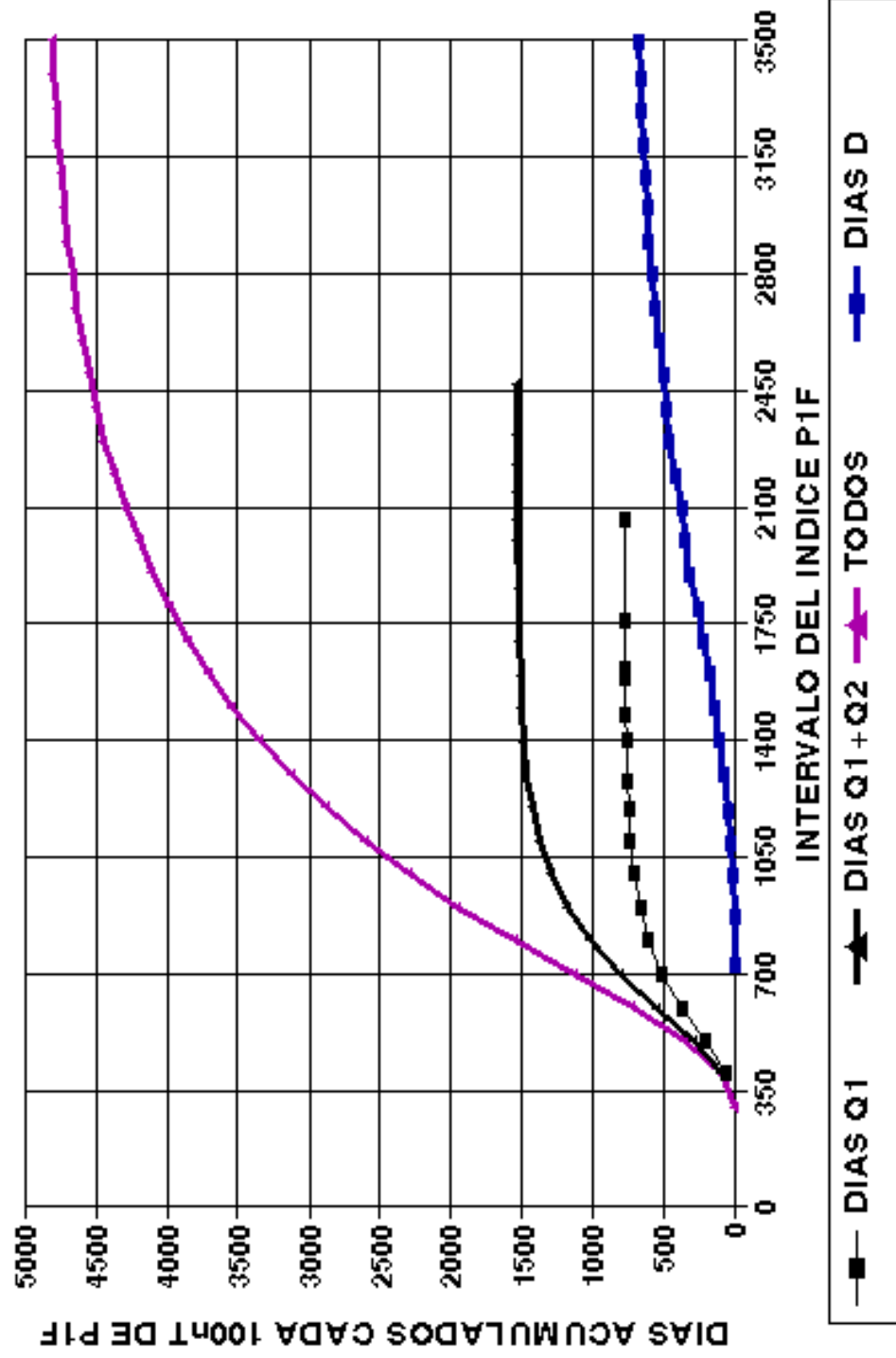
$$PIF_{DIARIO} = \sum_1^{1440} \left| F(t_j) - \langle F_{1h}(t_j) \rangle \right|$$

$$PIF_{\substack{\text{INTERVALO DE} \\ \text{K MUESTRAS}}} = \sum_1^K \left| F(t_j) - \langle F_{1h}(t_j) \rangle \right|$$

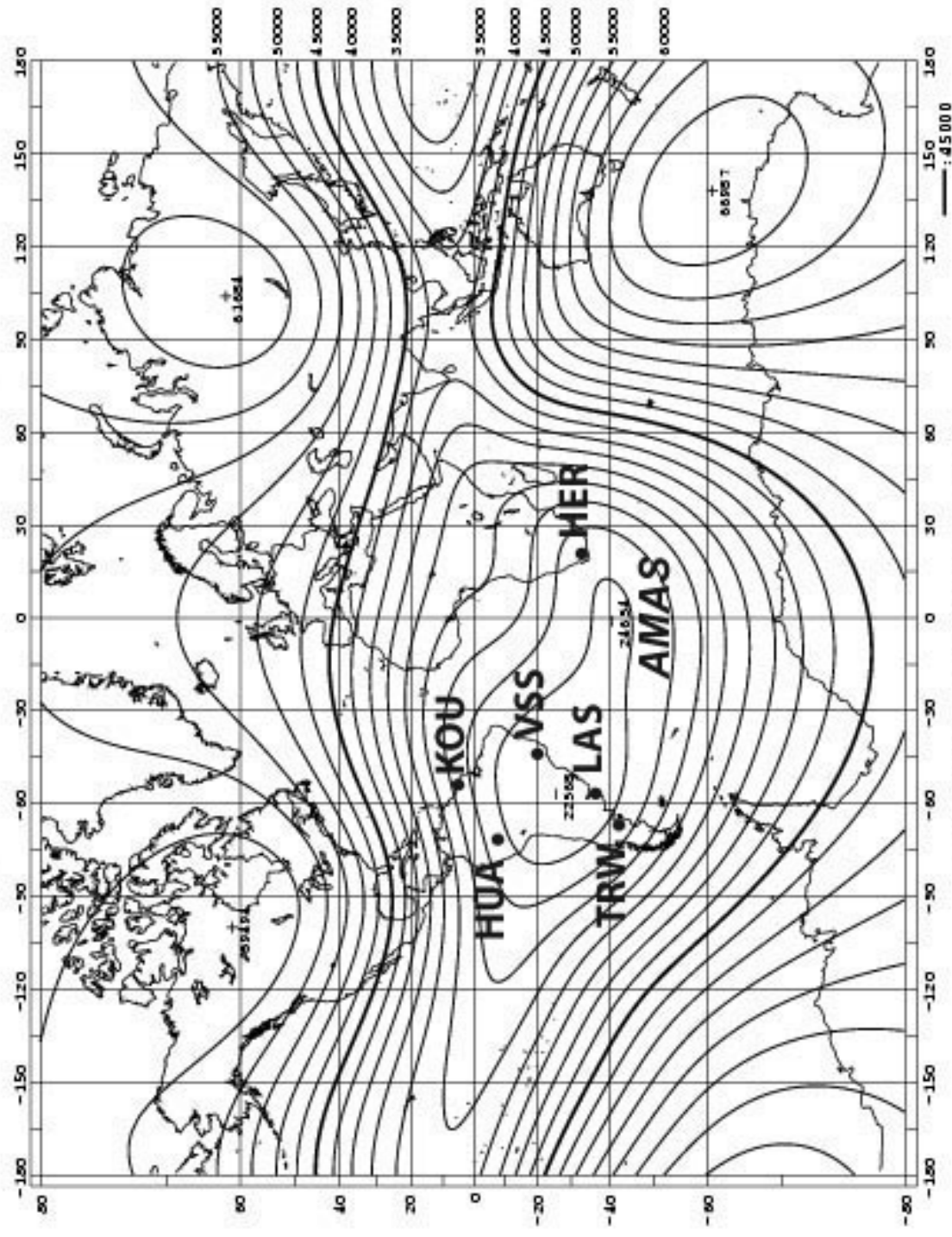
**CANTIDADES DE DIAS Q y DIAS DE TRELEW
SEGUN RANGO P1F. PERIODO 1993-2008**



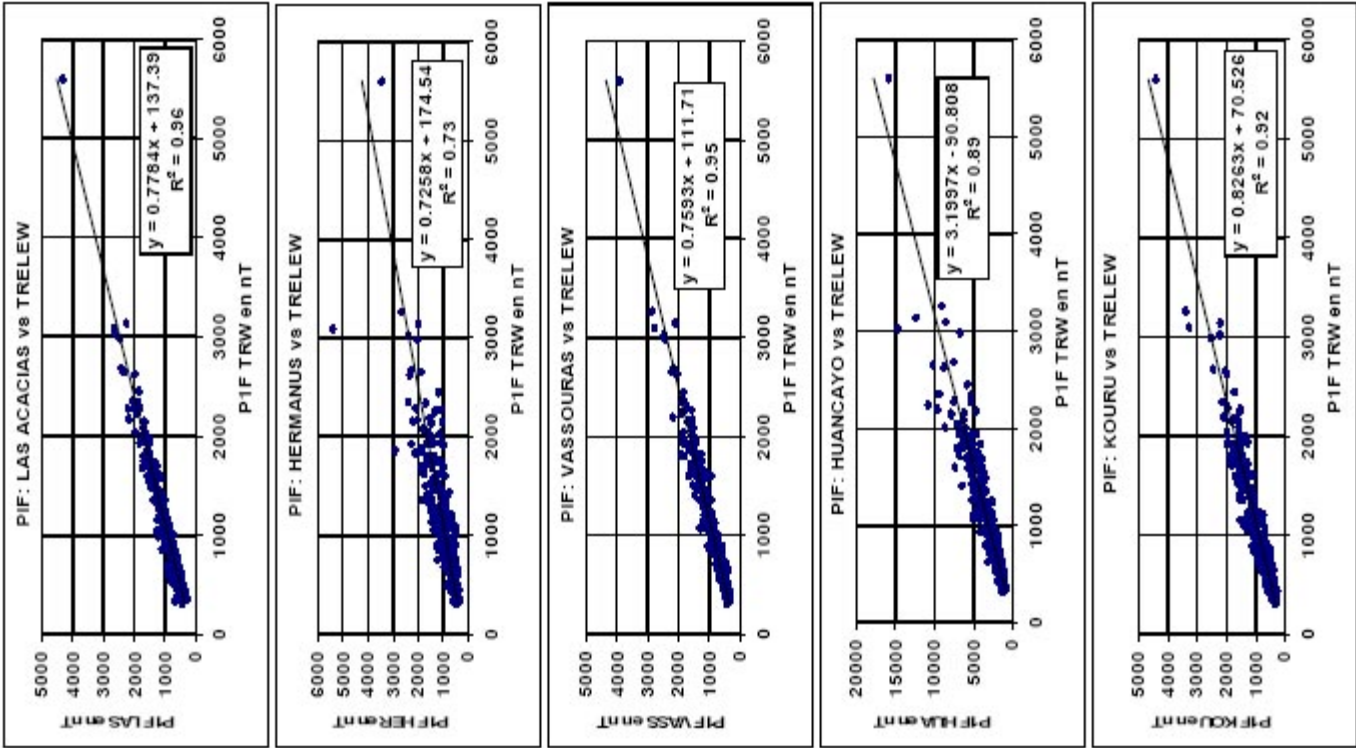
CANTIDAD DE DIAS Q1, Q1+Q2, Y TODOS
ACUMULADOS SEGUN P1F (1994-2009)



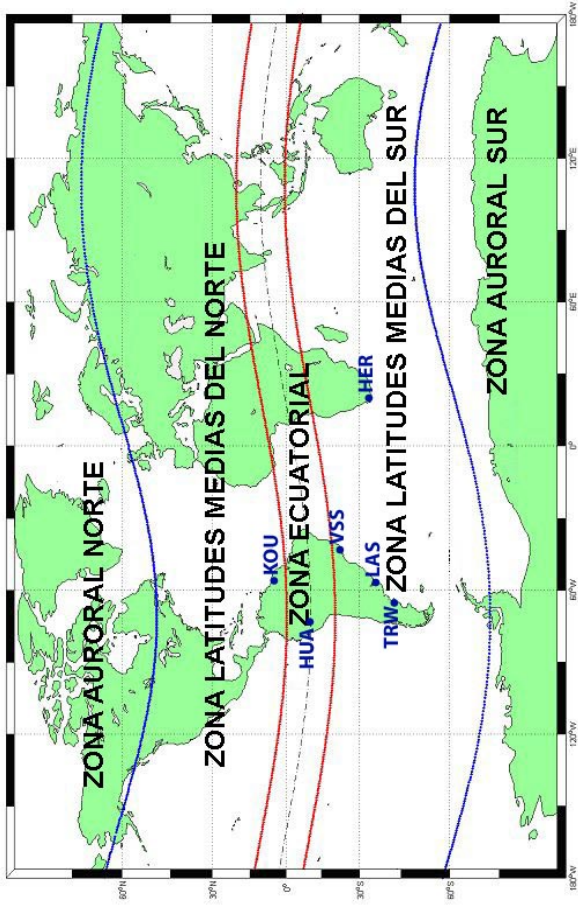
INTENSIDAD TOTAL F - IGRF 11 EPOCA 2010.0 **EQUIDISTANCIA ENTRE ISODINAS 2500nT**



COORDENADAS GEOGRAFICAS



OMP	VALOR LIMITE
Codigo	PARA P1F nt
TRW	700
LAS	680
HER	680
VSS	640
HUA	2100
KOU	640



MUCHAS GRACIAS !!!



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